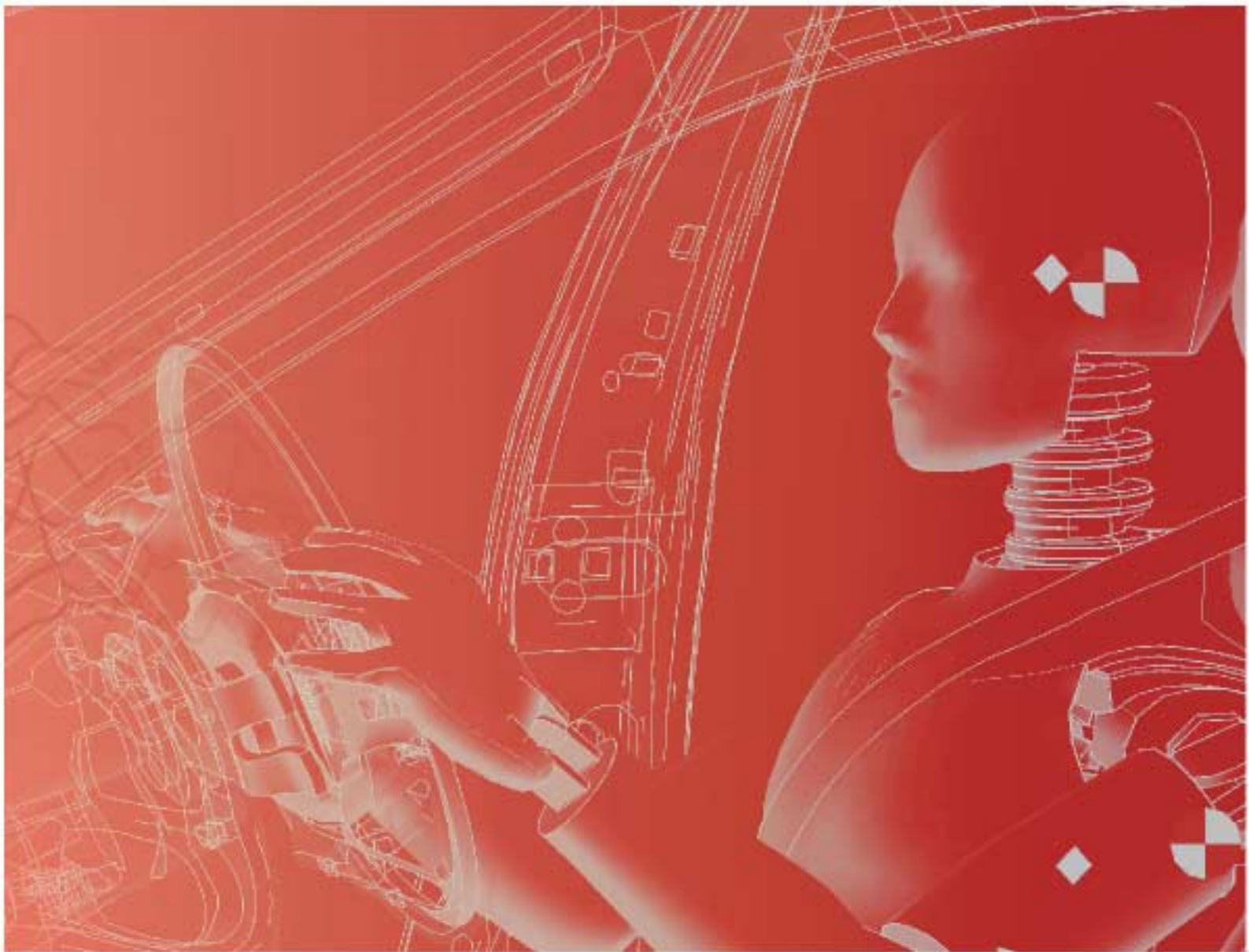


T/HIS

Version 9.4



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Text conventions used in this manual

Typefaces

Three different typefaces are used in this manual:

Manual text	This typeface is used for text in this manual.
Computer type	This one is used to show what the computer types. It is also used for equations, keywords (eg *PART) etc.
Operator type	This one is used to show what you must type.
Button text	This one is used for screen menu buttons (eg APPLY)

Notation

Triangular, round and square brackets have been used as follows:

- Triangular
To show generic items, and special keys. For example: <list of integers> <filename> <data component><return> <control Z> <escape>
- Round
To show optional items during input, for example: <command> (<optional command>) (<optional number>)

And also to show defaults when the computer prompts you, eg:

Give new value (10) :

Give model number (12) :

- Square
To show advisory information at computer prompts, eg
Give filename: [.key] :
THIS >>> [H for Help] :

1 Introduction

T/HIS is an x/y plotting program, specifically written to perform two functions:

1. To produce time-history plots from transient analyses, such as those performed using LS-DYNA.
2. To plot any form of x/y data that is produced either by a program or by directly typing in values.

T/HIS is a graphically driven, interactive program. Input and manipulation of data is through a graphical user interface on systems capable of running X-Windows applications; selections are made through "pressing buttons" using a mouse. On machines not capable of running X-Windows it is also possible to use T/HIS in a "command line" mode of operation; instructions are entered through the keyboard to perform the required operations.

1.1 Program Limits

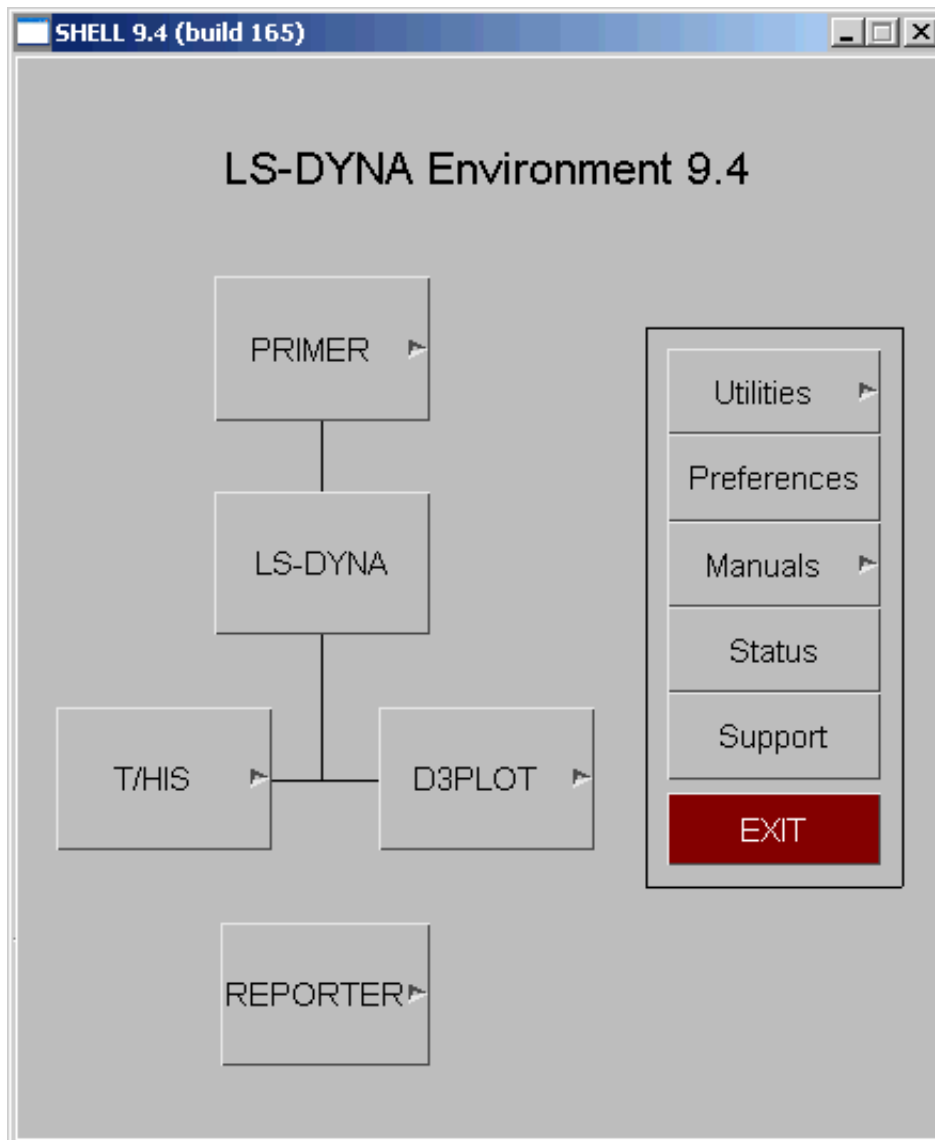
There are a number of limits in T/HIS of which the user should be aware. These are listed below:

Number of graphs	Version 9.4 of T/HIS can have a maximum of 32 graphs
Number of curves	The number of curves in version 9.4 is unlimited
Number of points	The number of points that can be defined per curve is unlimited.
Time-history blocks	In the interface to the LS-DYNA time-history (.thf) file there is a limit of 100,000 items in each of the node, solid, beam, shell and thick shell time-history blocks: thus 500,000 items overall. In the interface to the LS-DYNA extra time-history (.xtf) file up to 100,000 nodal reactions (or groups of reactions) may be processed.
Number of colours	By default, T/HIS curves wrap around the following six colours in order: WHITE RED GREEN BLUE CYAN MAGENTA However, a further 24 predefined colours are available if required and 6 user defined ones can be created.
Title	The title can contain up to 80 characters.
Labels	Labels for axes and lines can contain up to 80 characters.

1.2 Running T/HIS

1.2.1 Starting the code

For users on a device with a window manager T/HIS is run from the **T/HIS** button in the SHELL:



If your system has been customised locally you may have to use some other command or icon: consult your system manager in this case.

1.2.2 Graphics Driver

T/HIS 9.3 onwards use a new OpenGL graphics driver. In addition to the OpenGL driver the following platforms also contain a MESA driver for use with old versions of Xvfb (X Virtual Frame Buffer) that do not support OpenGL.

Platform	32 / 64 bit	OpenGL	MESA
Windows 2000, XP, Vista	32	YES	NO
Windows XP 64, Vista 64	32 & 64	YES	NO
Linux 2.4 kernel	32	YES	YES
Linux 2.6 kernel (Suse Enterprise 9 - 64 bit)	32 & 64	YES	YES
Linux 2.6 kernel (Redhat EL4 - 64 bit)	32 & 64	YES	YES
HP-UX 11.23 (ITANIUM)	32 & 64	YES	YES
HP-UX 11.00 (PA-RISC)	32 & 64	YES	YES
SUN Solaris 8	32	YES	YES
SUN Solaris 10	32 & 64	YES	YES
SGI IRIX 6	32 & 64	YES	YES
IBM AIX 5.1	32 & 64	YES	YES

Both the 32 and 64 bit versions of T/HIS use 32bit (single precision) numbers to store and plot data. The 32 bit version is limited to a maximum of 4GB of memory on all platform (3GB on windows).

1.2.2.1 "Batch" Mode

T/HIS 9.4 can run in "batch" mode where the main application window is not displayed on the screen. "Batch" mode is available on all platforms and it can be used with both the OpenGL and MESA drivers.

To start T/HIS in batch mode use the command line option "-batch".

e.g. `this94.exe -tcf=script.inp -batch`

When running in "batch" mode T/HIS will automatically exit at the end of the script regardless of whether or not "-exit" is specified.

NOTE : All image, postscript and PDF outputs require a DISPLAY on UNIX / LINUX systems. If you are running T/HIS in "batch" mode as part of a automatic post processing script then T/HIS must have a X Windows DISPLAY even though the main window is not displayed. If the machine you are using is a server or part of a cluster without an X-Server then T/HIS can be used with the Xvfb software.

1.2.3 Selecting a device when a window manager is not running

If you are running on a non-window device, for example a Tektronix display or emulator, you may not be able to use screen menus. Instead you will have to run in "command-line" mode.

It is very unlikely that a user on a modern workstation will see these options, since the machine will have a window manager and will be running in "screen menu" mode. If they do appear it suggests that the machine and/or software are wrongly set up: see 1.2.4 below for suggested remedies.

1.2.4 If T/HIS will not start in "screen-menu" mode

You may be running on a device with a window manager, but still only get the command-line prompt (and probably no menu driven _93 shell either).

This is almost certainly because of one or both of the following setup errors:

- (1) The DISPLAY environment variable has not been set up, or has been set incorrectly. This tells the X11 window manager where to place windows, and it must be set to point to your screen. Its generic setup string is:

setenv DISPLAY <hostname>:<display number> (C shell syntax)

Where <hostname> is your machine's name or internet address, for example:

setenv DISPLAY :0 (Default display :0 on this machine)

setenv DISPLAY tigger:0 (Default display :0 on machine "tigger")

setenv DISPLAY 69.177.15.2:0 (Default display :0, address 69.177.15.2)

You may have to use the raw network address if the machine name has not been added to your **/etc/hosts** file, or possibly the "yellow pages" server hosts file.

- (2) Your machine (strictly the X11 "server") has not been told to accept window manager requests from remote machines. This is usually the case when you are trying to display from a remote machine over a network, and you get the message similar to:

Xlib: connection to "<hostname>" refused by server

Xlib: Client is not authorised to connect to server

In this case go to a window with a Unix prompt on your machine, and type:

xhost +

Which tells your window manager to accept requests from any remote client. It will produce a confirmatory message, which will be something like:

access control disabled, clients can connect from any host

If T/HIS still fails to work then please contact your system manager, or contact Oasys Ltd for advice and help.

1.2.5 Command Line Mode

Command line mode is the main method of data input on non X-Windows devices. Command line mode is also available within the X-Windows screen interface and is accessed through the dialogue window. In command line mode the user will be presented with a prompt which also indicates which level of the menu structure the user is at. For example:

Defaults >

In response to the prompt a valid option must be given. These are usually a two or three letter abbreviation of a command; for example **PL** is the command to plot a graph. A list of the commands available is provided by typing **M** (for Menu). In addition to commands specific to one menu there are a number of commands which have the same effect throughout T/HIS.

- Q** - (Quit) Abort and return to current menu
- !** - Go up a level in the menu structure
- /** - Return to the top level menu
- ;** - Equivalent to a **<carriage return>** in a string of commands
- M** - Lists menu.

Several commands can be strung together on one line, separated by spaces, for example:

/DE GR ON

Numeric data can also be included in the command line if required, for example:

/OP ADX #1 7.2 #

Commands can be in upper or lower case.

As well as menu level commands you will be asked questions such as:

THF file to read (filename_1)?

The default response, if one exists, is given in parentheses.

1.3 Command Line Options

Instead of starting T/HIS using the Command shell it is also possible to start T/HIS from the command line with a number of optional input parameters. Starting T/HIS from the command line offers a number of advantages.

- Faster start-up is possible by pre-selecting the device type.
- The input filename can be specified and opened automatically.
- Faster start-up is possible by pre-selecting the device type

Argument format:

<application name> (<arg 1>) ... (<arg n>) (<input filename>)

T/HIS 9.4 can be started with a number of optional command line options

Graphics device type	-d=<device type> eg -d=default	Valid device types are: opengl OpenGL mesa Mesa tty No windows default OpenGL
Command file name	-cf=<filename> eg -cf=run_1.tcf	Any valid T/HIS command file filename
FAST-TCF input file	-tcf=<filename> eg -tcf=run_1.inp	Any valid T/HIS FAST-TCF command file filename
Settings file	-set=<filename> eg -set=this001.set	Any valid T/HIS settings file
LS-DYNA Model	<filename> eg run_1.thf	Any filename from the analysis
All the files associated with the model are opened and the contents scanned.		

LS-DYNA Model list Specify a file containing a list of models for T/HIS to automatically open.	-model_list=<filename> eg -model_List=job_list	The model list file should contain the full pathname of one file from each model that T/HIS should open. Each file should be on a separate line and it should be the first item on each line (other items separated with commas can be specified on the same line for use with REPORTER).
T/HIS curve file Specify a T/HIS curve file containing one or more curves for T/HIS to automatically open.	-cur=<filename> or -curve=<filename> eg -cur=test.cur	
T/HIS curve file list Specify a file containing a list of curve files for T/HIS to automatically open.	-curve_list=<filename> or -curve=<filename> eg -cur=test.cur	The curve list file should contain the full pathname of each curve file that you want T/HIS to open. Each file should be on a separate line.
T/HIS bulk data file Specify a T/HIS BDF file containing one or more curves for T/HIS to automatically open.	-bdf=<filename> eg -bdf=test.cur	
Automatically maximises the T/HIS window so that it occupies the full screen.	-maximise	
Specify a directory for T/HIS to start in.	-start_in=<directory>	Any valid directory
Set the width of the T/HIS graph window (in pixels)	-xres=<size> eg -xres=800	
Set the height of the T/HIS graph window (in pixels)	-yres=<size> eg -yres=600	
Stop and exit after command file	-exit	

Some examples for T/HIS might be:

```
pathname/this93.exe -d=x      (Use device X, open
run_2.thf              a .thf file)
pathname/this93.exe -d=tty    (No graphics, run
cf=batch.tcf -exit          command file)
```

Note that no spaces should be left in the syntax <arg>=<value>.

For example: "-d = x" is illegal.

Correct syntax is: "-d=x"

2 Using Screen Menus

[2.1 Basic screen menu layout](#)

[2.2 Mouse and keyboard usage](#)

[2.3 Dialogue input](#)

[2.4 Window management](#)

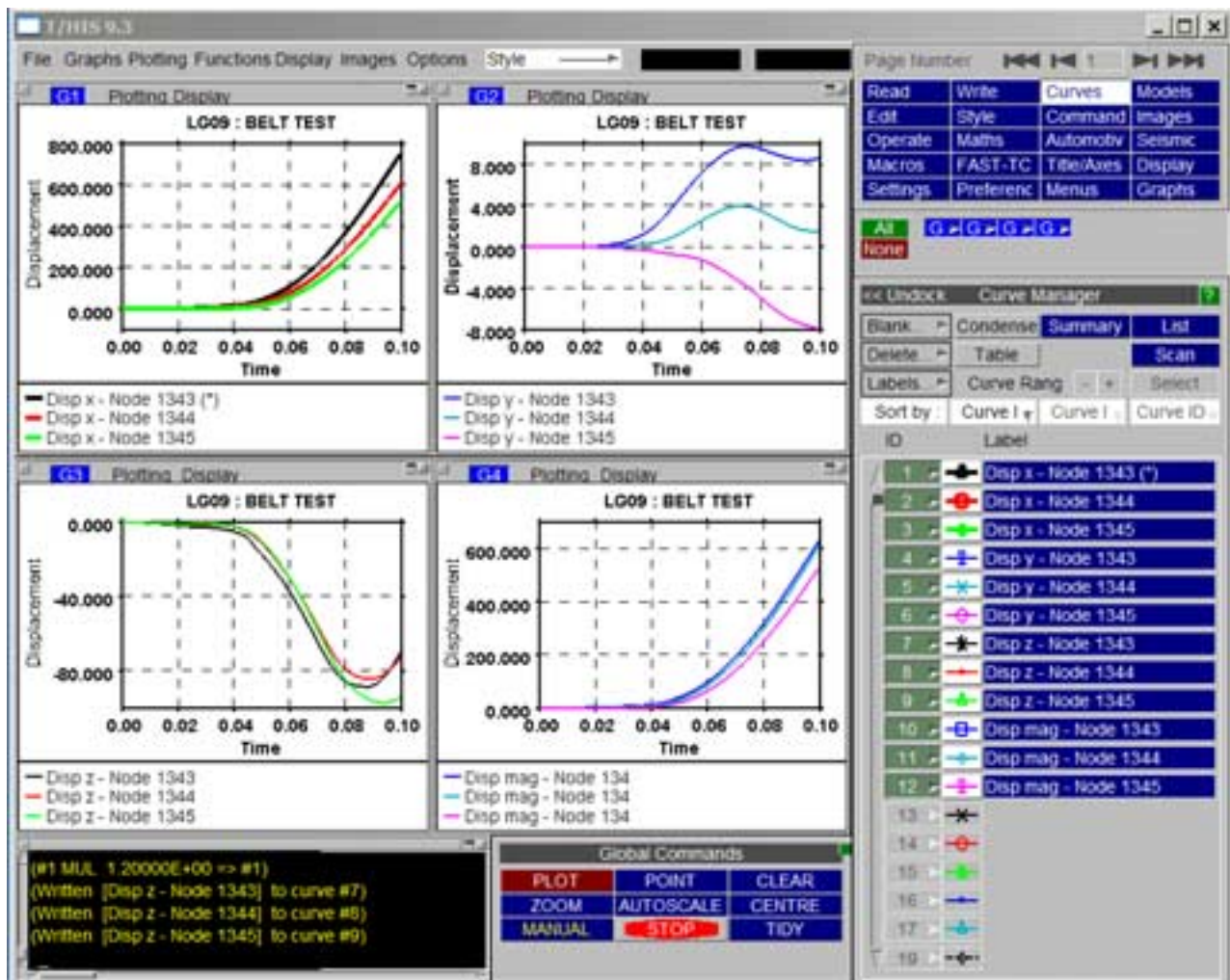
[2.5 Dynamic Viewing \(Using the mouse to change views\)](#)

[2.6 Graphics Box Options](#)

Versions of T/HIS prior to release 6.1 only had a "command-line" interface. This has been preserved for backwards compatibility, but a "screen-menu" interface has been added which allows you to drive the program almost entirely with the mouse.

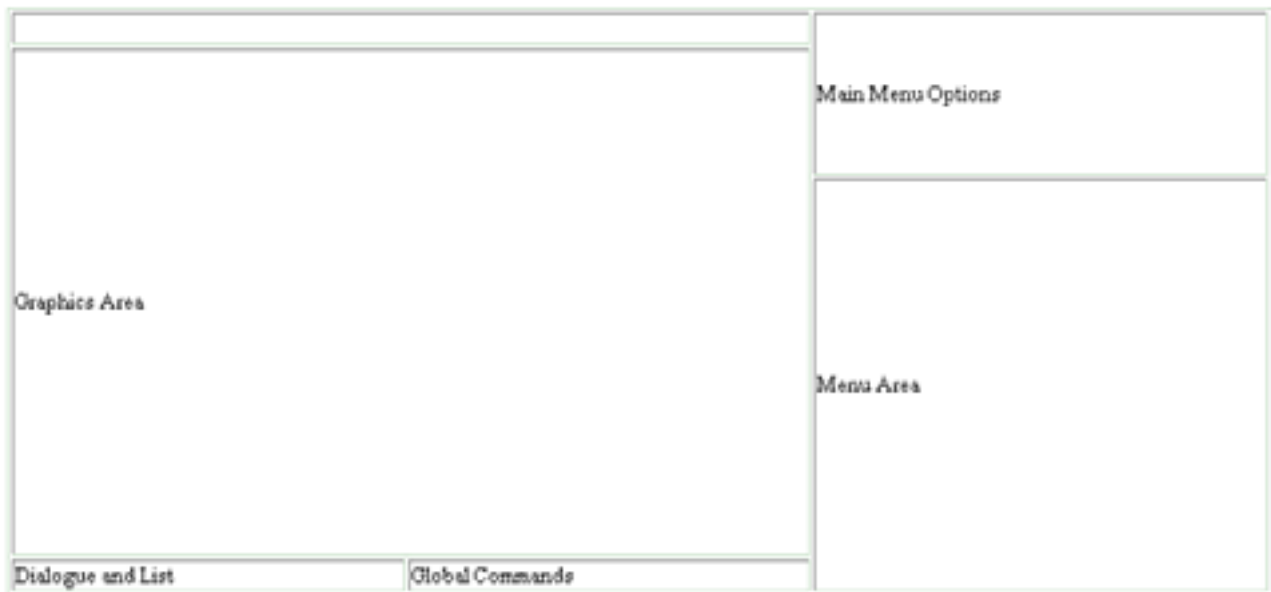
2.1 Basic screen menu layout

T/HIS runs within a single window, owned by the window manager, which has several sub-windows inside it. A typical T/HIS session will look like this:



The various sub-windows always exist within the master window, and may be moved and resized at will inside it. They will keep their relative size and position as the master window is changed in size and/or shape, and will reappear after the main window is de-iconised.

The default layout of the main sub-windows is as follows:



These windows cannot be dismissed. A brief description of their functions is:

Main Menu Options	Provides access to the majority of the commands and options available in T/HIS through a series of sub menus (see Section 6).
Graphics area	Is where graphs are drawn. In T/HIS 9.4 this area can contain a maximum of 32 graphs (see Section 3). Alternativley if graphs have been organised into pages (see Section 3.3) then this area will display a single page of graphs.
Dialogue & list	Allows "command-line" input and output, also provides a listing area for messages.
Menu Area	Displays the commands and options associated the current selection fromthe main menu options.
Global Commands	Gives access to commonly used commands (see Section 4).

While you are free to reposition these master windows it is recommended that you keep to this default layout. This is because when further sub-windows appear their position and size is designed assuming this layout, and aims to obscure as little useful information as possible.

2.2 Mouse and keyboard usage for screen-menu interface

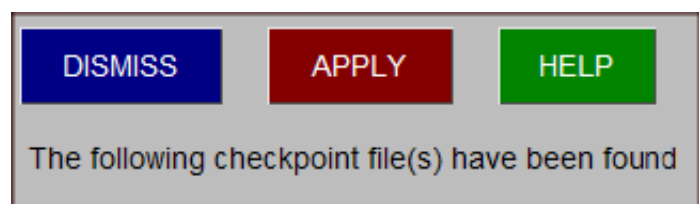
All screen-menu operations are driven with the left mouse button, with the following exceptions:

- (a) Text in the dialogue area and text boxes requires keyboard entry.
- (b) Text strings saved in the cursor "cut" buffer may be "pasted" into dialogue areas and text boxes using the middle mouse button.

The primitive "widgets" in the menu interface are used as follows:

BUTTONS:

Screen buttons are depressed by clicking on them, but action only takes place when the mouse button is released, so it is safe to drag the (depressed) mouse around the screen.



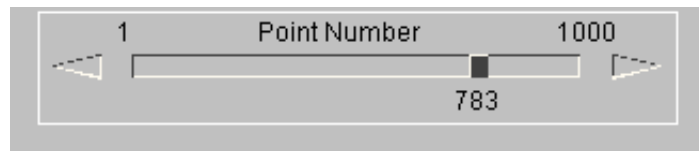
Buttons may also be greyed out to indicate that the option is not currently available. Buttons with "..." after them will usually invoke sub-menus.

"Popup" window invocation: Buttons with an ">" symbol may be selected normally with the left mouse button, but if the *right* mouse button is depressed over them it will invoke a "popup" window. Holding the right mouse button down move the cursor into this window to make a selection, or move elsewhere and release the button to deactivate the popup.



SLIDERS:

Sliders are moved by clicking on the slider button itself, and then dragging it to a new position. They may also be moved automatically by clicking on, and holding down, one of the arrows at either end.



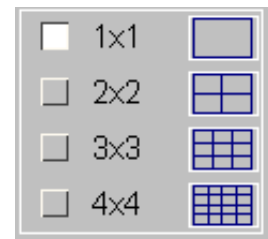
TEXT BOXES:



To enter text in a text box: first make it "live" by clicking on it, then type in text, then type **<return>** to enter the string. Clicking on a "live" box for a second time is exactly the same as typing **<return>**, so clicking twice on a box effectively enters its current contents. You can use the left and right arrow keys for line editing within a box: text entry takes place after the current cursor position.

RADIO BOXES

A "radio" set is provided where only one selection is possible from a range of options. In this example the postscript laser output has been set to a single image per page.

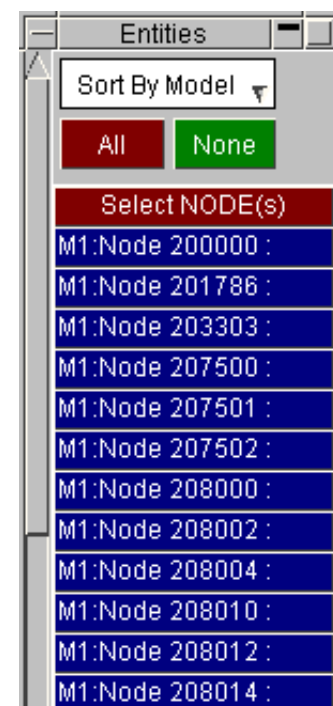


MENU SELECTIONS:

Menus of items are used when you need to make one or more selections from a (potentially) long list. Click on the row you want to select: clicking on a row that is already selected will have the effect of unselecting it. When the list is too long to display in the window you can use the vertical scroll-bars to move up and down it.

A range of items may be selected by either

- 1) Click on the first item and hold down the mouse key, drag the mouse to the last item in the list. All items between the first and last including the first and last are selected.
- or
- 2) Click on the first item, hold down the SHIFT key and click on the last item in the list. All items between the first and last including the first and last are selected.



2.3 Dialogue input in the screen menu interface

The full command-line capability is preserved when T/HIS is running in screen-menu mode, and you are free to mix command-line and mouse-driven input at will. There are some situations in which command-line input is more efficient: for example when entering lists of explicit entities.

Commands are entered in the dialogue box:



As this example shows the dialogue box is also used for listing messages, warnings and errors to the screen. It can be scrolled back and forth (its buffer is 200 lines long) to review earlier messages. The following colours are used:

Normal messages and prompts	Yellow
Text typed in by you	White
Warning messages	Magenta
Error messages	Red

There is a minor limitation when mixing command-line and screen-menu mode: you cannot perform the same function simultaneously in both modes. If you attempt to do so you will get the message:

WARNING: recursive access attempted

And you will not be permitted to continue.

2.4 Window management in the screen interface

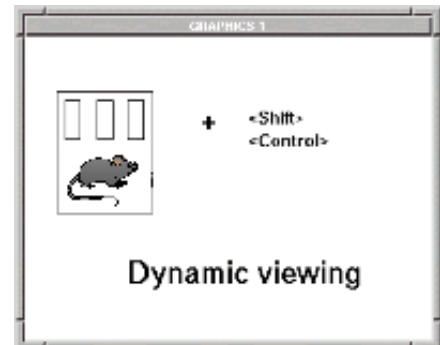
Moving, resizing and scrolling of windows is based on the conventions used in the Motif Window Manager.

- To move a window:** Click down on its title bar, then drag the window to where you want it to be. A "rubber-band" outline moves to show the window's current position.
- To resize a window:** Either
- Click on a border bar to move just that side, or on a corner bar to move both sides attached to that corner. Again, a rubber-band outline shows you the new shape.
- or
- Use the **MAXIMISE** button  in the top right hand corner of the window to increase the size of the window to the largest possible size.

- To scroll a window:** If a window has got too small for its contents then horizontal and/or vertical scrollbars will appear. Click on a scrollbar slider and move it to the desired position, the window contents will scroll as you do so. Alternatively click on the arrows at either end of the scrollbar for timed motion in that direction.
- To minimise a window:** Click on the button  in the top right hand corner of the window. When a window has been iconised it will appear in the **ICON** area at the bottom of the screen.
- To restore a window:** Iconised windows may be restored by clicking on the icon in the ICON area.

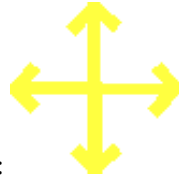
2.5 Dynamic Viewing (Using the mouse to change views).

"Dynamic" viewing is the name given to the process in which you perform viewing transformations by moving the mouse around the screen.



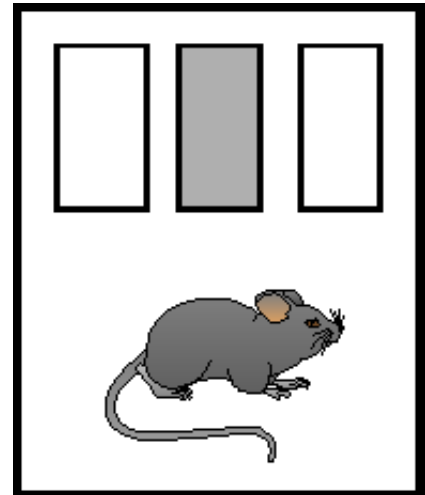
2.5.1 Dynamic Translation.

Dynamic translation uses **<mid mouse> + <left shift>**



The cursor symbol is yellow, and looks like:

The relationship between mouse and image motion is intuitive: the object tracks the mouse motion in the screen XY plane. The initial position of the mouse is irrelevant.



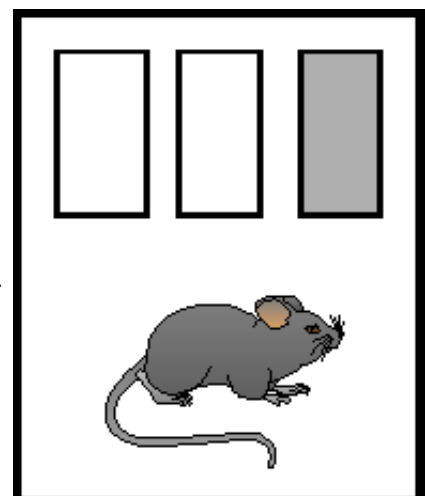
2.5.2 Dynamic Magnification (Scaling).

Dynamic scaling uses **<right mouse> + <left shift>**



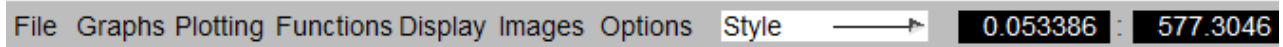
The cursor symbol is green, and looks like:

Mouse motion to the right and up makes the image larger, left and down smaller. The initial position of the mouse is irrelevant. A horizontal movement will scale just the x-axis while a vertical movement will scale just the y-axis.



2.6 "Tool Bar" Options

Across the top of the main graphics window are a number of buttons that can be used to access other T/HIS menus (see [Section 6.1](#)) for more details..



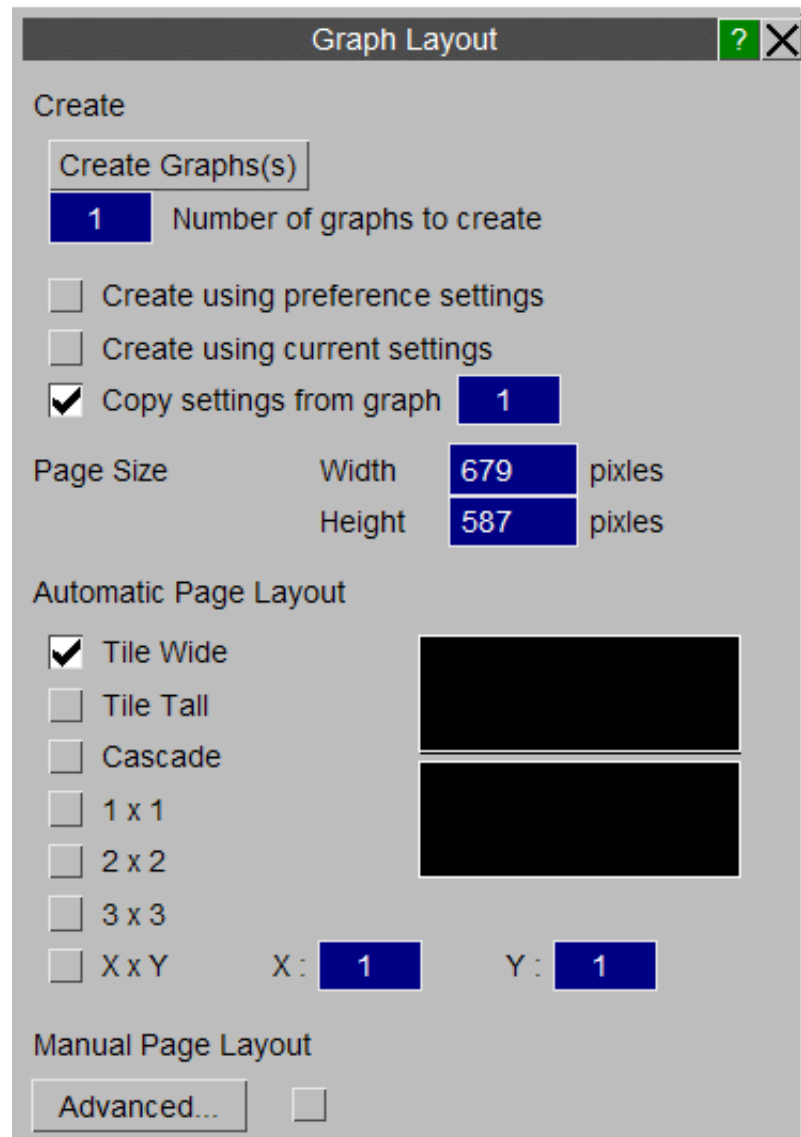
If the graphics box is [maximised](#) to take up the whole of the main window these buttons can be used to access the rest of the T/HIS menus without having to resize the graphics box between commands. Almost all of the options and functions in these menus may also be accessed from other menu locations, e.g. the Main Menu area.

3 GRAPHS AND PAGES

- [3.1 Creating Graphs](#)
- [3.2 Page Size](#)
- [3.3 Page Layouts](#)
- [3.4 Pages](#)
- [3.5 Active / Inactive Graphs](#)

T/HIS 9.4 can display a maximum of 32 graphs. Each graph can have a different appearance and they can display different curves.

Graphs can be laid out using a number of different formats and they can be organised into 'Pages'.

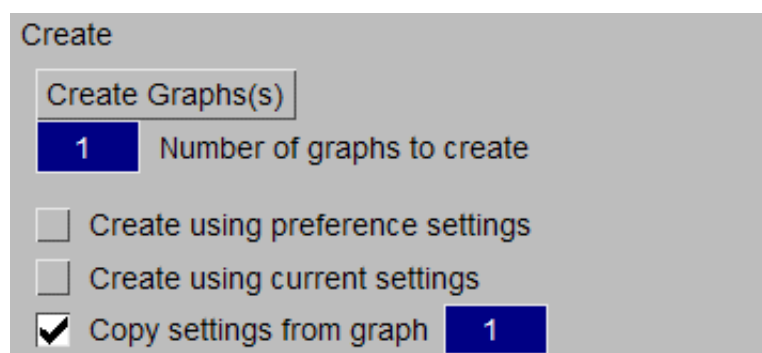


3.1 Creating Graphs

Create Graphs Create a new graph.

The [shortcut key](#) 'G' can also be used to create new graphs.

Number of graphs to create This option can be used to create multiple graphs.



When new graphs are created the initial settings for each graph can be copied from 3 different sources.

- Create using preference settings

The [Display](#) and [Axis Settings](#) are copied from the preference file.
- Create using current settings

The [Display](#) and [Axis Settings](#) are copied from the current settings in the Display and Axis menus.
- Copy settings from graph n

The [Display](#) and [Axis Settings](#) are copied from the specified graph.

3.2 Page Size

These options can be used to specify the total size of the area (in pixels) used by the graph windows.

Page Size	Width	679	pixels
	Height	587	pixels

3.3 Page Layouts

3.3.1 Automatic Page Layout

If an Automatic page layout is used and the layout is set to [1 x 1](#), [2 x 2](#), [3 x 3](#) or [X x Y](#) T/HIS will automatically create multiple pages and position the graphs on each page if required.

Automatic Page Layout

☒ Tile Wide

☐ Tile Tall

☐ Cascade

☐ 1 x 1

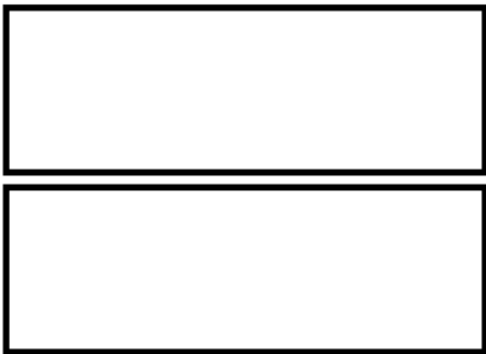
☐ 2 x 2

☐ 3 x 3

☐ X x Y

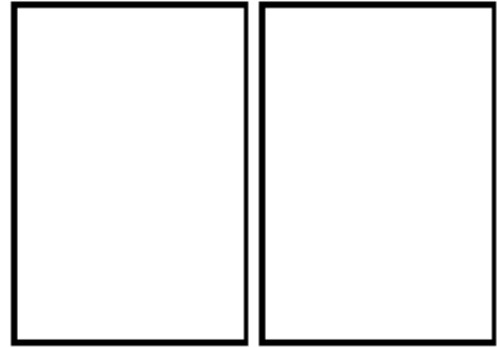
X : 1Y : 1

Tile Wide
All of the graphs are positioned on a single page.

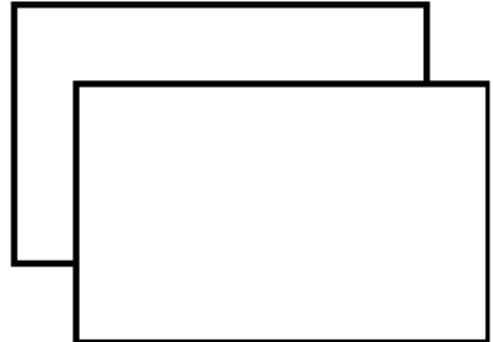


Tile Tall

All of the graphs are positioned on a single page.

**Cascade**

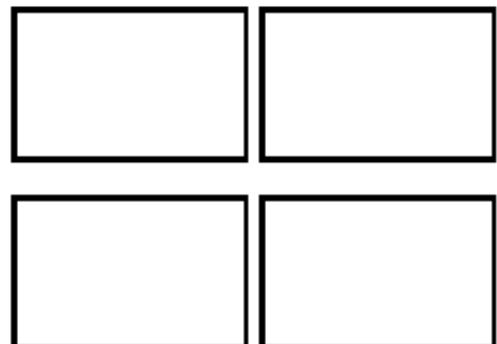
All of the graphs are positioned on a single page

**1 x 1**

Each graph is positioned on it's own page.

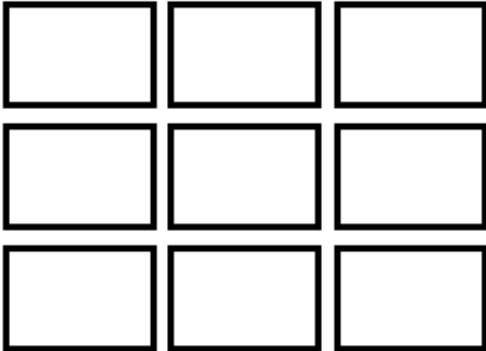
**2 x 2**

Graphs are arranged in a 2 by 2 grid. If there are more than 4 graphs then graphs 1 to 4 are positioned on page 1, 5 to 8 on page 2 ...



3 x 3

Graphs are arranged in a 3 by 3 grid. If there are more than 9 graphs then graphs 1 to 9 are positioned on page 1, 10 to 18 on page 2 ...



X x Y

Graphs are arranged in a X by Y grid.

3.3.2 Manual Page Layout



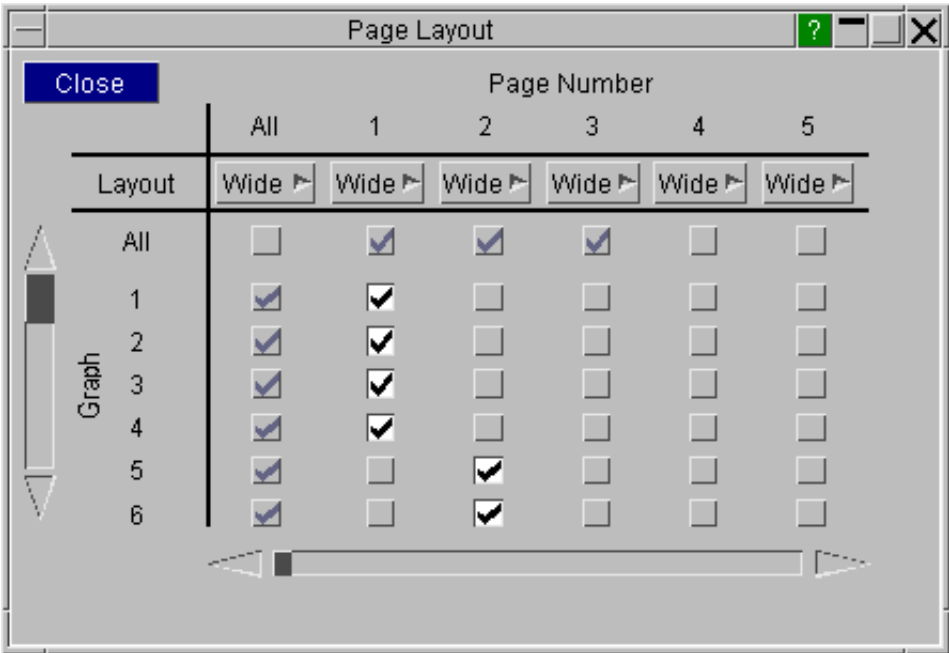
Manual page layout can be used to give more control over which graphs appear on which page. Unlike the Automatic page layouts a graph can appear on more than one page.

Advanced

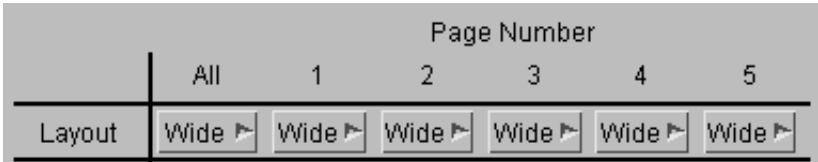
The Advanced option displays the Page Layout menu.

This menu can be used to select which graphs appear on each page. Each graph can appear on more than one page.

A range of graphs can be added/removed from pages by selecting the first graph/page combination and then holding down **SHIFT** while selecting the second graph/page.

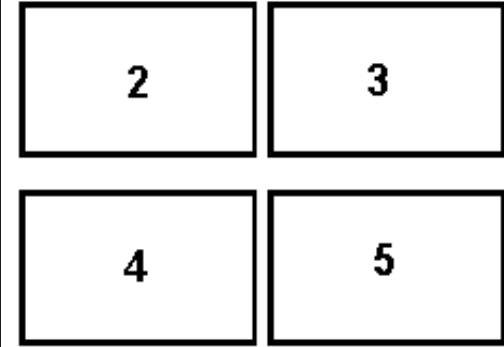
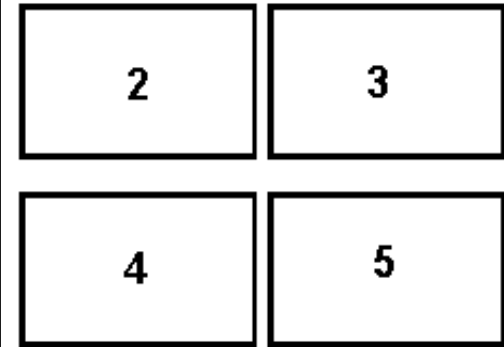
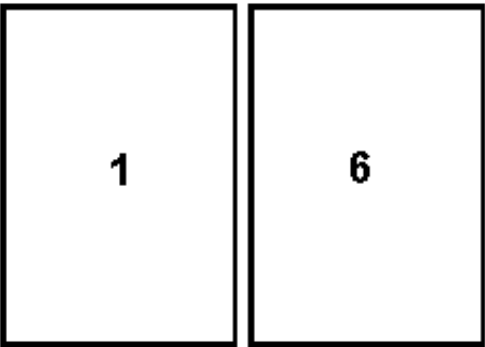
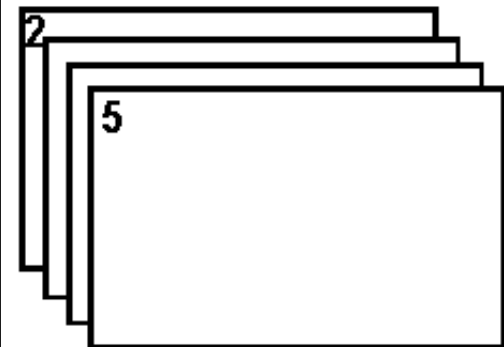
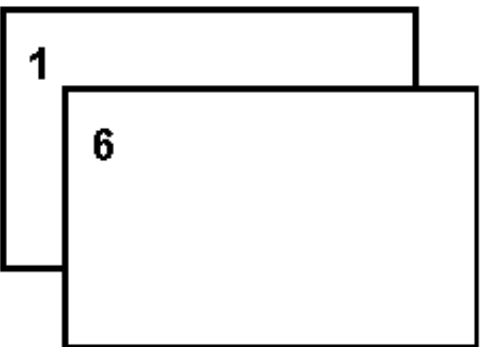
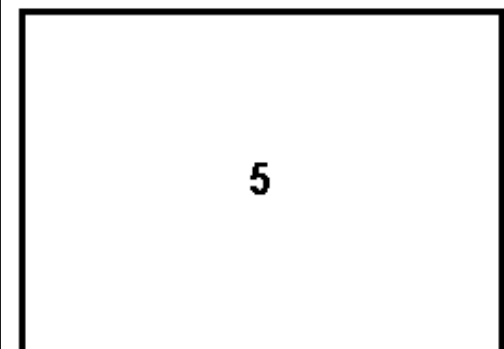
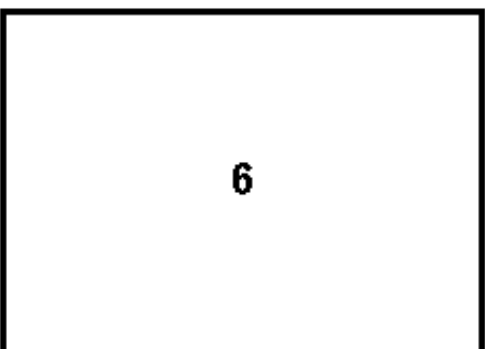


Each page can have a different layout or they can all be the same.



With the Advanced option the **Graph Layout** options work in exactly the same way as the [Automatic Page Layout](#) options, except they only position the graphs defined on each page.

If for example T/HIS has 6 graphs defined and graphs 2,3,4,5 are defined on page 1 and graphs 1 and 6 are on page 2 then the different graph layout options would produce the following.

	Page 1	Page 2
Tile Wide		
Tile Tall		
Cascade		
1 x 1 (stacked on top of each other)		

2 x 2	2 3 4 5	1 6
3 x 3	2 3 4 5	1 6
X x Y	Layout depends on X and Y	Layout depends on X and Y

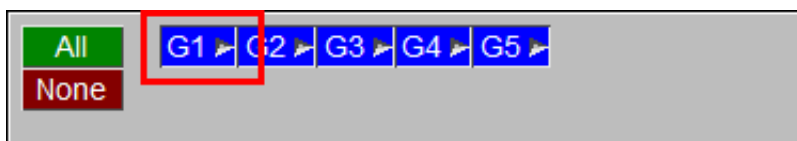
3.4 Pages

T/HIS can have a maximum of 32 pages, each page can contain multiple graphs. For more information on selecting the currently displayed page [see Section 4.1](#). The [Image Output](#) options and the [FAST-TCF Create](#) option can produce output for either a single page or multiple pages if graphs are located on more than one page.

3.5 Active Graphs

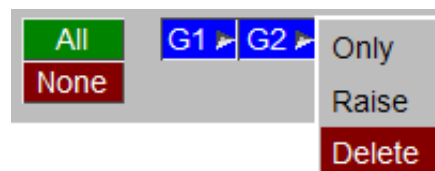
If T/HIS contains more than one graph then each graph can be toggled between being active or inactive.

All the graphs can be activated using the **All** button or deactivated using the **None** button.

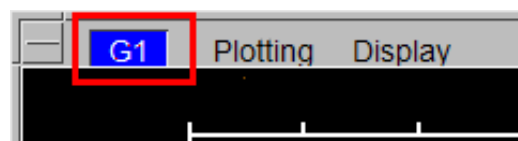


There is a popup menu attached to each button that can be used to select that graph **Only**, **Raise** the graph so that it is in front of any others or to **Delete** the graph.

When a graph is deleted any graphs with higher numbers are renumbered downwards to remove any gaps in the graph numbering.



Graphs can also be activated / deactivated using the button located in the top left hand corner of each graph.

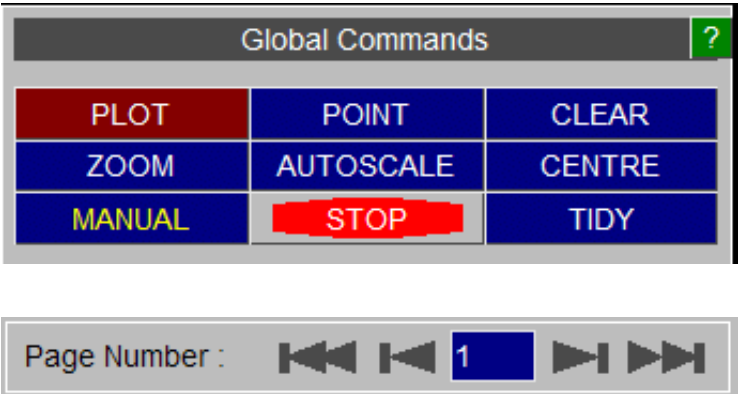


The options in the [Display](#) and [Title/Axes](#) menus that control the appearance of graphs are only applied to active graphs.

When new curves are created by reading in data from files the new curves are automatically unblanked in all of the currently active graphs and blanked in any inactive graphs.

4 Global Commands and Pages

- [4.1 Page Number](#)
- [4.2 PLOT](#)
- [4.3 POINT](#)
- [4.4 CLEAR](#)
- [4.5 ZOOM](#)
- [4.6 AUTOSCALE](#)
- [4.7 CENTRE](#)
- [4.8 MANUAL](#)
- [4.9 STOP](#)
- [4.10 TIDY](#)
- [4.11 Additional Commands](#)



The following commands are to be found as buttons on the **GLOBAL MENU** panel. (The command line codes are given in parentheses.)

All of the commands in the GLOBAL MENU can also be accessed via the **PLOTTING** button at the top of the graphics window.

4.1 Page Number

If T/HIS contains more than one graph ([see section 3.1](#)) then the graphs can be positioned on seperate Pages within T/HIS. This menu can be used to select a specific page or it can be used to step through the pages one by one.

	Shortcut Key	
	Goto Page 1	Home
	Go back 1 Page	Page Up
	Goto Page (n)	N/A
	Go back 1 Page	Page Down
	Goto Page 32	End

4.2 PLOT (PL)

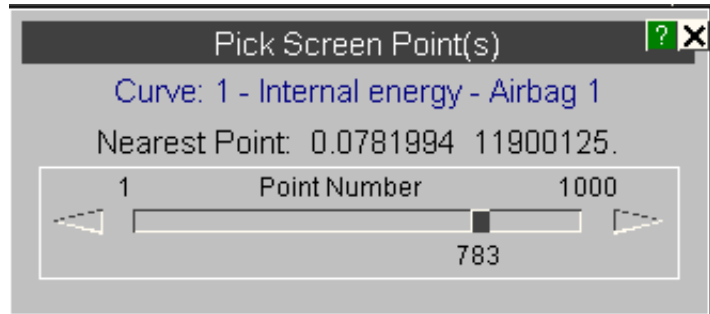
This option will plot all the curves that are currently UNBLANKED (see [Section 5](#)).

4.3 POINT (PT)

When selected this option waits for the user to pick a point in the main graphics screen.

Once a point has been picked the <x> and <y> values of the point picked are reported along with the ID of the nearest curve and the nearest point on that curve.

After a point has been selected on the screen the slider may be used to move to other points along the same curve.



4.4 CLEAR (CL)

Clears the graphics screen.

4.5 ZOOM (ZM)

The cursor appears on the screen and may be used to select the required plot area by choosing opposite corners of a box. The graphs are then replotted. Using **ZOOM** implicitly turns autoscaling off.

4.6 AUTOSCALE (AU)

Autoscales the plot size for all current unblanked curves in the graphics window and re-displays the plot.

4.7 CENTRE (CE)

Pick a point on the screen using the cursor to be the new plot centre. It affects the x/y offsets but not the scales.

4.8 MANUAL

Displays the online (HTML) version of the manual

4.9 STOP

Some operations, like reading a file containing many curves in to T/HIS, can take a long time. This button can be used to stop some long operations without having to exit from T/HIS.

4.10 TIDY

This option can be used to reset the menu layout to the default settings.

4.11 Additional Commands

A number of additional global commands exist in command line mode. These functions exist in screen menu mode within other menu levels.

- (PF)** Creates a postscript plot file. Either A4 landscape or A4 portrait formats may be chosen. A title and figure number are also requested. Other plot setting may be made in the command line mode **UTILITIES** menu.
- (BL)** Blank a currently displayed curve.
- (UB)** Unblank a curve that has been blanked.
- (RM)** Remove (delete) a curve. Once a curve has been removed it is lost from the system.
- (ER)** Erase (delete) all existing curves from T/HIS. (Equivalent to the command **RM * .**)
- (GS)** Global status: displays the current number of curves, their labels and whether they are blanked.
- (CO)** Condense: renumbers all curves to fill any gaps in curve numbers.
- (LM)** Gives the current program limits.
- (FT)** File tracking: lists the 20 files which have been accessed most recently by T/HIS, giving details of the type of file and whether it was read from or written to.
- (EX)** Exits (leaves) the program.

5 Main Menu

- [5.1 READ Options](#)
- [5.2 WRITE Options](#)
- [5.3 CURVE Manager](#)
- [5.4 MODEL Manager](#)
- [5.5 EDIT Options](#)
- [5.6 STYLE Menu](#)
- [5.7 Command File](#)
- [5.8 IMAGE Options](#)
- [5.9 OPERATE Options](#)
- [5.10 MATHS Options](#)
- [5.11 AUTOMOTIVE Options](#)
- [5.12 SEISMIC Options](#)
- [5.13 MACRO Options](#)
- [5.14 FAST-TCF Options](#)
- [5.15 TITLE/AXES Options](#)
- [5.16 DISPLAY Options](#)
- [5.17 SETTINGS Menu](#)
- [5.18 PREFERENCES Menu](#)
- [5.19 GROUPS Menu](#)
- [5.20 GRAPHS Menu](#)
- [5.21 PROPERTIES Menu](#)
- [5.22 UNITS Menu](#)

Read	Write	Curves	Models
Edit	Style	Properties	Images
Operate	Maths	Automotive	Seismic
Macros	FAST-TCF	Title/Axes	Display
Settings	Preferences	Groups	Graphs
Command File	Units		

The **MAIN MENU** provides access to a number of separate menus that perform most of the operations available within T/HIS from reading in data to producing postscript laser files.

5.0 Selecting Curves

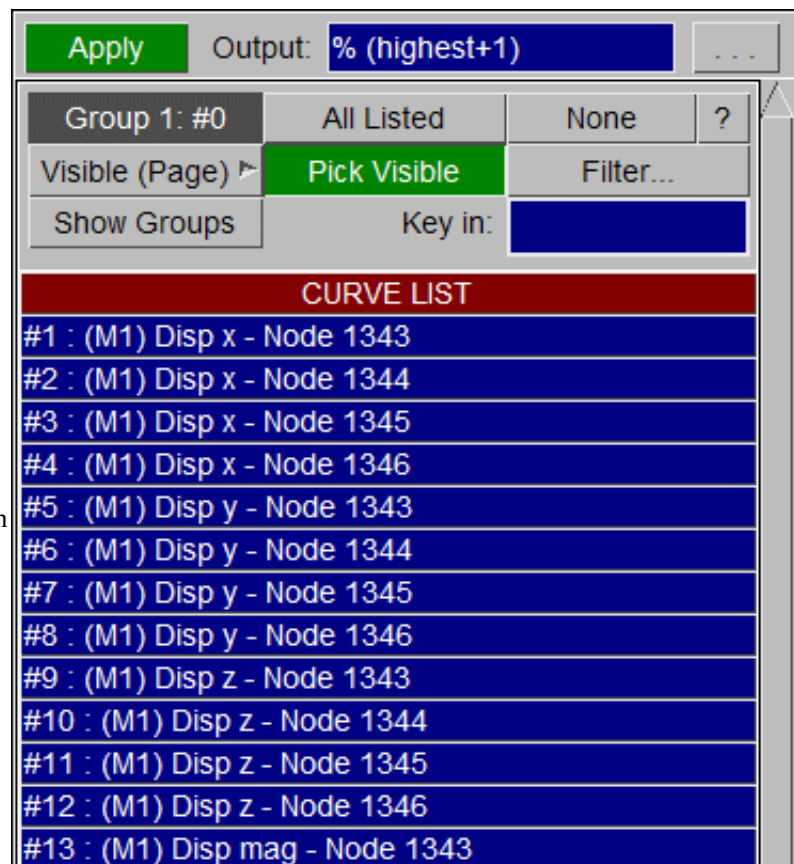
5.0.1 Input Curves

By Curve ID

A number of the menus require a range of curves to be selected. When a range of curves has to be selected a menu containing a list of the available curves will be displayed (see figure, right).

A range of curves may be selected by either

1. Click on the first item and hold down the mouse key, drag the mouse to the last item in the list. All items between the first and last including the first and last are selected.
2. Click on the first item, hold down the SHIFT key and click on the last item in the list. All items between the first and last including the first and last are selected.



VISIBLE (Page)

This option will select all of the curves that are unblanked in any graph on the current page.

Visible (Page) ▶

Visible on Page

Visible All Pages

Explain This

VISIBLE (All Pages)

This option will select all curves that are unblanked in at least one graph.

PICK_VISIBLE

Alternatively curves may be picked from the screen. With this option the left mouse button is used to select curves while the right button deselects curves. As each curve is selected/deselected its name and number will be reported to the user and it will be highlighted on the screen.

A range of curves can be selected interactively by dragging out an area on the screen while holding down the left mouse button.

FILTER...

This option can be used to filter the list of curves displayed by model. When this option is selected a list containing all of the current models in T/HIS is displayed and the models can be selected or deselected. Any curves that belong to a deselected model will then be filtered out of the curve list.

SHOW GROUPS

This option will display a list of the currently defined curve groups instead of curves

By Curve Group

In addition to selecting individual curves it is also possible to select curves by [Curve Group](#) if they have been defined.

- If a curve is defined in more than one group then it will be selected if at least one of the groups is selected.
- If more than one group containing the same curve is selected then the curve will only be counted once as an input curve.

Apply		Output: % (highest+1)	...
	All Listed	None	?
Visible (Page) ▶	Pick Visible	Filter...	
Show Curves	Key in:		
CURVE GROUP LIST			
#1 : Curve Group 1 - Displacements			
#2 : Curve Group 2 - Velocities			
#3 : Curve Group 3 - Accelerations			

By Command Line

In command line mode a single curve may be selected by typing in a range. A valid syntax is:

A single curve number	e.g. #27
A "from":"to" range	e.g. #10:#30 (no gaps, ":" mandatory)
A compound list in "(..)"	e.g. (#1 #2 #10:#30 #3 #97)

In all contexts the order in which a group is defined does NOT influence the order in which it is processed. It is ALWAYS processed in ascending sequential order.

Thus the addition operation

```
/OP ADD (#30 #20 #10) (#1 #2 #3) #40
```

will produce the results

```
#40 = #10 + #1
```

```
#41 = #20 + #2
```

```
#42 = #30 + #3
```

5.0.2 Output Curves

All operations that generate new curves must have a target curve defined. This must be one of the following:

#nnn	a specific curve number nnn
#	meaning "the lowest free curve"
%	meaning "the highest free curve"

In all cases output will start at the relevant curve number, however defined, and will rise sequentially with no gaps. This can cause an existing curve to be overwritten, or the output curve number to exceed the limit of 999. Both conditions are checked for: a warning is given if either will occur should the operation go ahead, and an opportunity given to modify or abort the pending operation.

There is a further output option that is only valid for operations where the input is a curve group:

- .** meaning "overwrite the input curve(s)"

In this case the input curves are overwritten without warning. For example, this option might be used to integrate a set of curves, overwriting the original results with the integrated values.

Any curve number between 1 and 999 may be used as an input or output curve. It is not necessary to use curves sequentially; gaps are permitted in curve number usage. Therefore curves #1 and #10 can be used, for example, without having to use the intervening curves #2 to #9. Likewise, deleting a curve will no longer cause those above it to be renumbered downwards to fill the gap.

5.0.3 Curve Operations

The functions available fall into three distinct groups,

- 1) Separate functions involving two groups of curves, where the result is of the form:
 $\langle R_n \rangle = \langle G_{1n} \rangle [OP] \langle G_{2n} \rangle$
- 2) Separate functions involving only one group of curves, where the result is of the form:
 $\langle R_n \rangle = [OP] \langle G_{1n} \rangle$
- 3) Single output from only one group of curves, where the result is of the form:
 $\langle R \rangle = [OP] \langle G_{1(1...n)} \rangle$

1) Separate Functions On Two Groups

These functions display a menu in which **two** groups of curves may be selected, (see right).

You must define one or more curves in group #1, and group #2 must be:

- either A group of as many curves as there are in group #1.
- or A single curve. Every curve in group #1 is applied to this curve.
- or A constant value, entered in the **Key in:** text box.

You can pick curves in either group from their menus, or type a range into the **Key in:** box.

NOTE : the order in which they are processed is ascending sequential, **not the order in which you define them.**

Apply		Output: % (highest+1)		...
Group 1: #0	All Listed	None	?	
Visible (Page) ▾	Pick Visible	Filter...		
Show Groups	Key in:			
CURVE LIST				
#1 : (M1) Disp x - Node 1343				
#2 : (M1) Disp x - Node 1344				
#3 : (M1) Disp x - Node 1345				
#4 : (M1) Disp x - Node 1346				
#5 : (M1) Disp y - Node 1343				
#6 : (M1) Disp y - Node 1344				
#7 : (M1) Disp y - Node 1345				
CURVE LIST				
#1 : (M1) Disp x - Node 1343				
#2 : (M1) Disp x - Node 1344				
#3 : (M1) Disp x - Node 1345				
#4 : (M1) Disp x - Node 1346				
#5 : (M1) Disp y - Node 1343				
#6 : (M1) Disp y - Node 1344				
#7 : (M1) Disp y - Node 1345				

2) Separate Functions On A Single Group

These functions display a menu in which one group of curves may be selected, (see right).

Operations apply separately and uniquely to each selected curve.

As before, the order of processing is ascending sequential, not the order in which you define them.

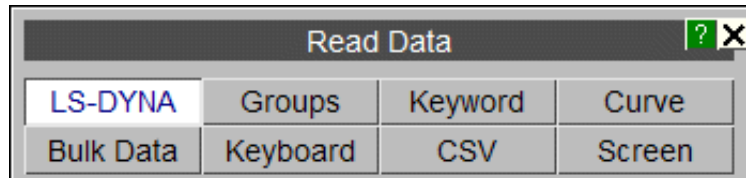
Apply		Output: % (highest+1)	...
Group 1: #0	All Listed	None	?
Visible (Page) ▾	Pick Visible	Filter...	
Show Groups	Key in:		
CURVE LIST			
#1 : (M1) Disp x - Node 1343			
#2 : (M1) Disp x - Node 1344			
#3 : (M1) Disp x - Node 1345			
#4 : (M1) Disp x - Node 1346			
#5 : (M1) Disp y - Node 1343			
#6 : (M1) Disp y - Node 1344			
#7 : (M1) Disp y - Node 1345			
#8 : (M1) Disp y - Node 1346			
#9 : (M1) Disp z - Node 1343			
#10 : (M1) Disp z - Node 1344			
#11 : (M1) Disp z - Node 1345			
#12 : (M1) Disp z - Node 1346			
#13 : (M1) Disp mag - Node 1343			

3) Single Output From A Single Group

These functions require a single group of curves as input like the functions above. The output is a single curve.

5.1 READ Options

T/HIS can **READ** data from a number of sources including LS-DYNA binary output files, LS-DYNA ASCII files and tabulated x/y data files. In addition this menu allows data for new curves to be entered directly using the keyboard.



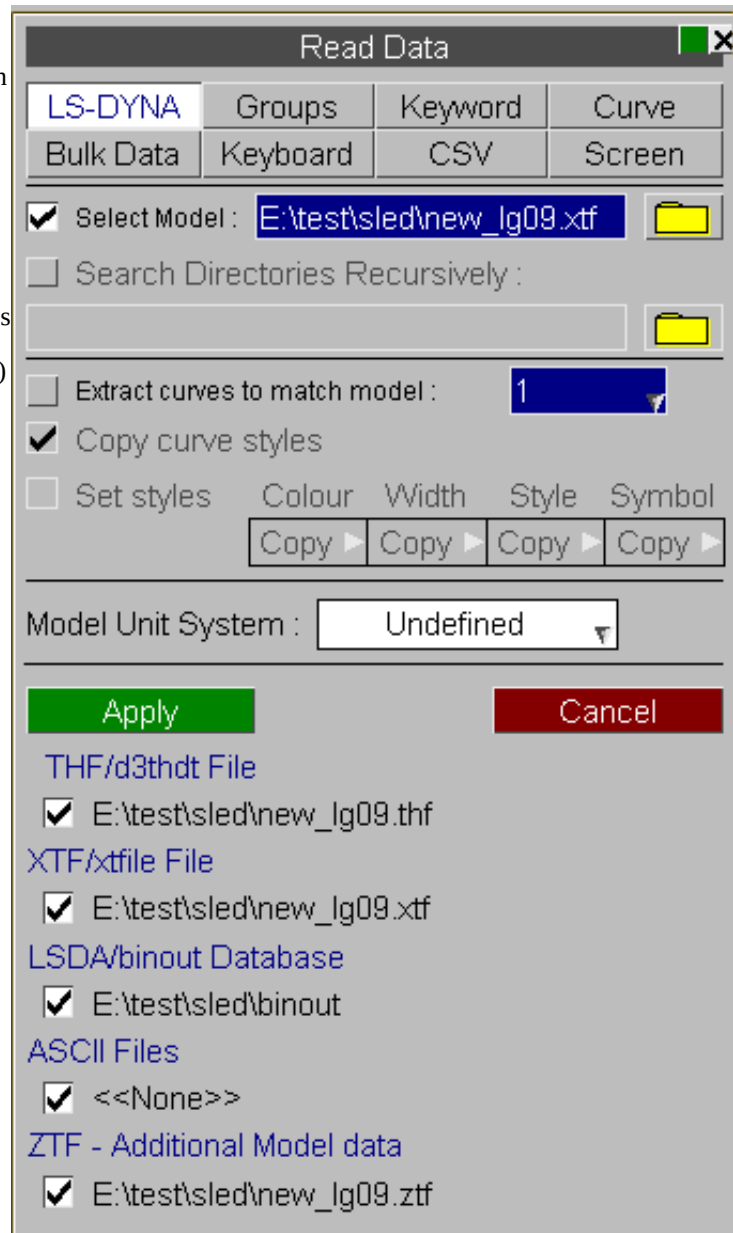
5.1.1 LS-DYNA

There are two possible methods of reading LS-DYNA output files into T/HIS.

Select Model

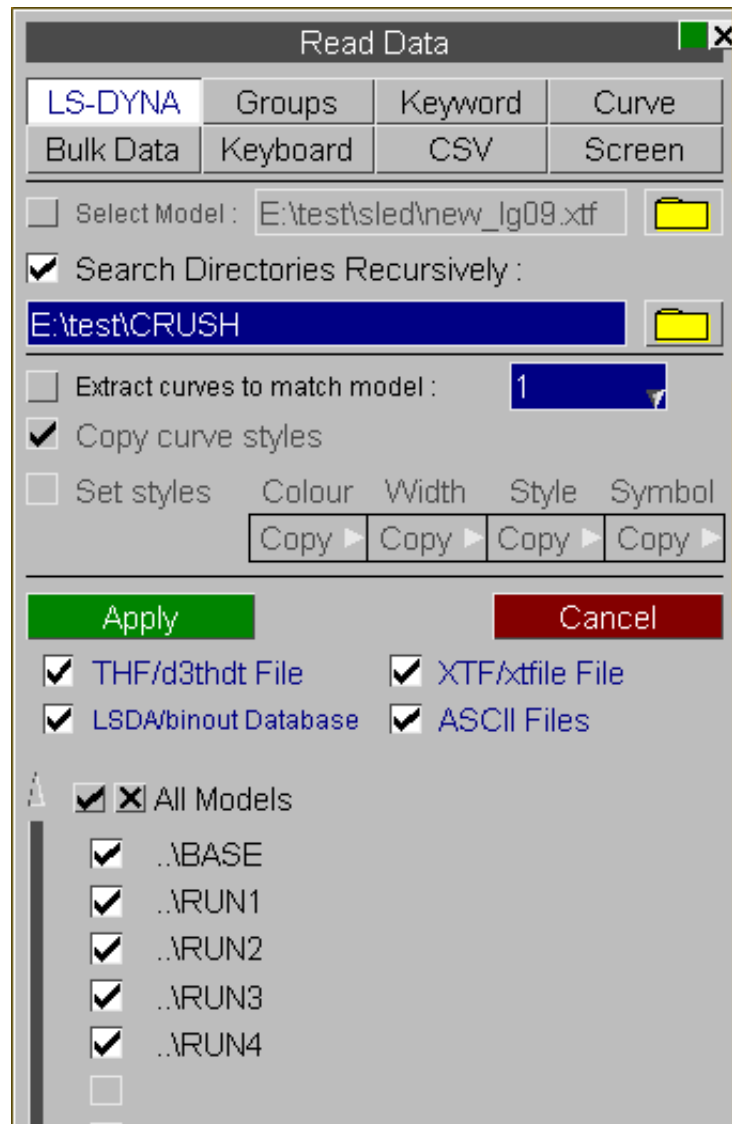
Select any results file from a model. T/HIS will then search for all the results files in that directory produced by the same analysis as the selected file (as illustrated on the right) and display a list of all the files found. The user can then select which files to open. The default is to open all the available results files.

When the user selects **Apply** the selected file are then opened and the contents scanned. After the files have been scanned the list of available data types will automatically be displayed ([see Section 5.1.1.5](#))



Search Directories

Select a directory. T/HIS will then search the directory and all subdirectories recursively for models and results and list them so the user can select which models to read.



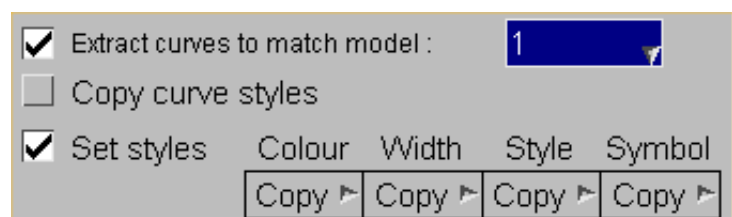
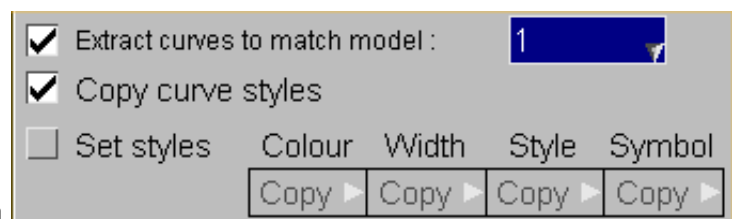
5.1.1.2 Automatic extraction of model results

When a second or subsequent model is opened in T/HIS this option can be used to automatically generate the same curves as those already read from another model.

By default this option will attempt to generate curves that match those already read from model 1. If results have already been read from more than one model then the model to match the curves form can be set to any of the existing models.

When the curves from the 2nd or subsequent model are automatically generated they will be given the same colours, and line styles as the curves in the original model.

Instead of copying the curve styles a new style for all the automatically generated curves can be specified. This make it very easy to set the same style for all of the curves that are read from a model.



5.1.1.3 Model Unit System

This option can be used to set the default Unit System that will be applied to the model. For more information on Units see [Section 5.22](#)

5.1.1.4 Entity Types

Items are shown in bright green if they occur in all the models that have been read into T/HIS and are currently selected. If they occur in at least one model but not all models then they are shown in a duller green (in the case shown in the adjacent picture Beams and Joints can be found in some but not all of the models).

Model Unit System :

Read Data			
LS-DYNA	Groups	Keyword	Curve
Bulk Data	Keyboard	CSV	
Global	Parts	Part Groups	Nodes
Solids	Beams	Shells	Tk Shells
Stonewalls	Springs	Airbags	Contacts
Geo Contacts	Seatbelts	Retractors	Sliprings
Reactions	Joints	X Sections	Subsystems
Nodal RBs	Spotwelds	SPCs	Boundaries
FSIs	SPHs		

5.1.1.5 Data Components

When reading data from any of the LS-DYNA binary files or the LS-DYNA ASCII files multiple components and entities may be selected at the same time.

Each data extraction menu consists of a list of available data components and a list of entities.

Data Components

Individual data components can be selected using the mouse. If a component has been selected and a second item is subsequently selected the first item will be deselected.

Multiple components may be selected by

1. Holding down the **CTRL** key when selecting items to add individual items to the list of selected components.
2. Holding down the **SHIFT** key when selecting items to add a range of items to the list of selected components.
3. Clicking on the first item to be selected and then dragging down the list of items without letting go of the mouse button.

Select Models	New Model	Reread Model
Model Title :		
Output curve: # (first free)		
Key in :		
Data Components		Apply
KE - Kinetic energy IE - Internal energy HG - Hourglass energy TE - Total energy XM - X momentum YM - Y momentum ZM - Z momentum VX - Average X velocity VY - Average Y velocity VZ - Average Z velocity MA - Added mass		Entities Sort By Model All None Select PART(s) M1:Part 1 : (UPPER M1:Part 54 : (UPPE M1:Part 69 : (RIDED M1:Part 70 : (BREA M1:Part 1000 : (WIN M1:Part 1001 : (FLO M1:Part 1002 : (TOE M1:Part 1003 : (SEA M1:Part 1006 : (SEA M1:Part 1110 : (KNE M1:Part 1136 : (RIGI M1:Part 1137 : (RIGI M1:Part 1138 : (KNE

5.1.1.6 Entities

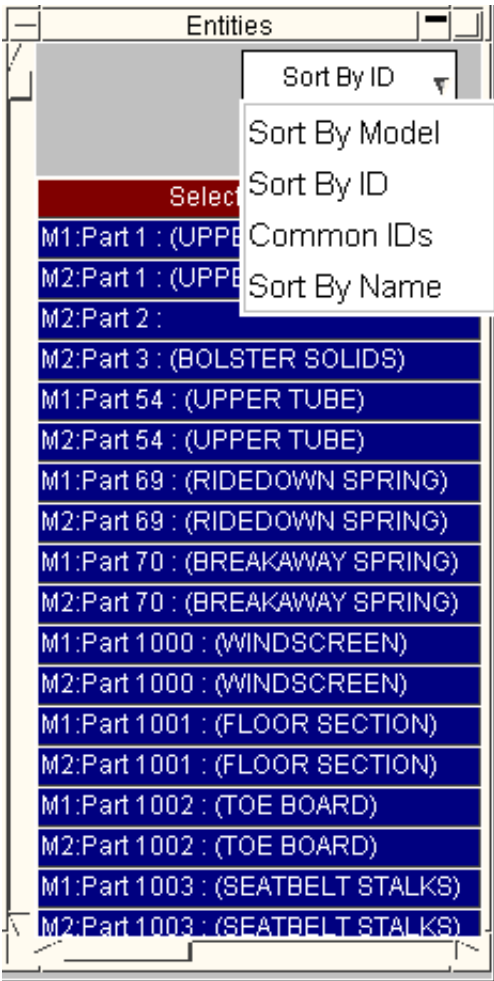
Individual entities can be selected/deselected using the mouse.

Multiple entities may be selected by

1. Holding down the **CTRL** key when selecting items to add them to the list of selected entities.
2. Holding down the **SHIFT** key when selecting items to add a range of items to the list of selected entities.
3. Clicking on the first item to be selected and then dragging down the list of items without letting go of the mouse button.

Entities can be sorted in four ways:

Sort by model	will list all entities in the lowest number model in order of ascending ID number, then all entities in the next-lowest model, and then move through the rest of the models in ascending order.
Sort by ID	will list all entities in ascending order showing the model ID for each entity
Common IDs	will list only the entities with IDs that are common to all models without showing the model ID's
Sort by Name	arranges the entities in alphabetical order based on their names.



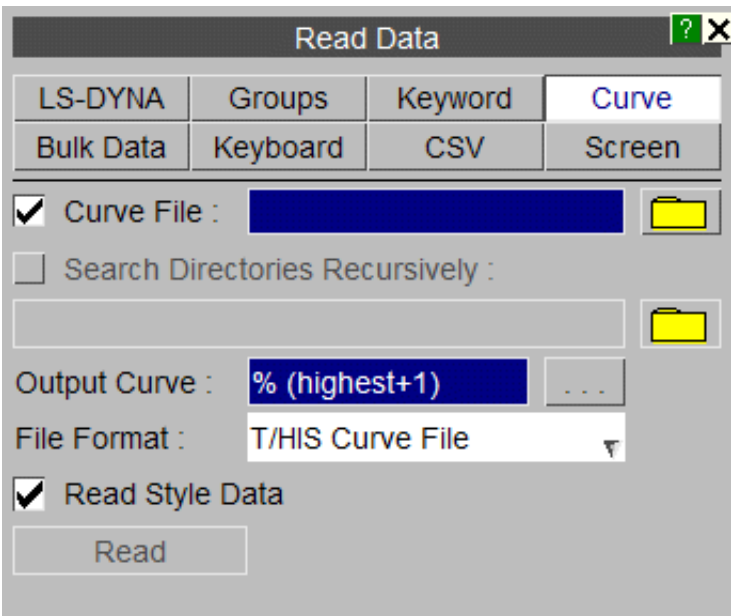
5.1.2 GROUPS

This option can be used to read a file containing PART group definitions. If a model is read in which contains PART information then the PART groups can be used to read in and sum energies for a group of PARTS in one go.

5.1.3 CURVE

This option can be used to read data in from an ASCII file.

In addition to reading a single file this option can also be used to search directories recursively for multiple files. After the search has finished a list showing all of the files that have been found will be displayed so that multiple files can be selected and read in one operation.



The different file formats supported are :

T/HIS Curve file	This is the default T/HIS curve file format. As well as reading this format T/HIS can also write out curves (include style information) using this format. For more details on the format see Appendix B .
ISO (Multiple Channels)	Read multiple channels of data from an ISO/TS 13499:2003 format file.
ISO (Single Channel)	Read a single channel of data from an ISO/TS 13499:2003 format file.
LS-PREPOST	This is the format used by LS-PREPOST

T/HIS Curve File

ISO (Multiple Channels)

ISO (Single Channel)

LS-PREPOST XYDATA

5.1.4 KEYWORD

Read data into T/HIS from an LS-DYNA KEYWORD input file. All X,/Y data defined using ***DEFINE_CURVE** will be read in from the specified input file. Any X and Y axis scaling or offsets defined within the ***DEFINE_CURVE** definition will be applied to the X,Y as it is read in. If the **_TITLE** option has been used the title will be used as the curve label otherwise the curve ID number will be used.

In version 9.3 onwards this option will also process any files specified using the ***INCLUDE** option.

```
/re kw "filename" read all curves from KEYWORD input file "filename"
```

5.1.5 BULK

Read data into T/HIS from a Bulk Data file. The format of a Bulk Data file is described in [Appendix C](#).

```
/re bd "filename" read all curves from Bulk Data file "filename"
```

5.1.6 KEYBOARD

Key in curve information directly. A dialogue window is displayed upon requesting this option where the user will be prompted for title, x and y axis labels, a curve identifier and then a series of points. Once all the points required have been entered carriage return should be pressed. The user will then be prompted for the curve or file in which to store this data : # means use the next free curve.

5.1.7 CSV

The **CSV** menu (see right) can be used to specify the name of a comma separated variable file to read into T/HIS.

The file may contain up to 1000 columns of data (separated by commas).

The maximum line length supported by this option is 10240 characters.

Read Data

LS-DYNA Groups Keyword Curve

Bulk Data Keyboard **CSV**

File contains :

CSV File :

Curve : ...

File Format: X,Y,Y,Y,Y,Y,Y,Y ▼

X-AXIS

☒ Read X Values Column :

☐ Generate X Values Start :

Interval :

LABELS

☒ Read Labels Row :

☐ Generate Labels

Read

Read X Values

This option can be used to specify a column within the file that contains the X-axis data values that should be used for all of the other columns of data.

Generate X Values

This option can be used to automatically generate the X-axis values if none of the columns within the file contain the data.

Read Labels

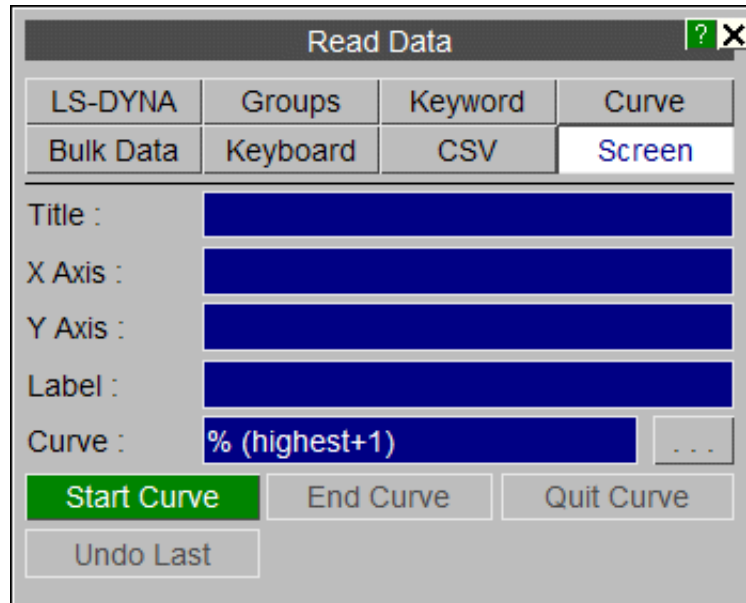
This option can be used to specify a row within the file that contains labels for each of the columns of data that can be used as the curve labels within T/HIS.

Generate Labels

This option can be used to automatically generate labels for each set of data. A single string can be specified which will then have the column number appended to it to generate unique labels.

5.1.8 SCREEN

The **SCREEN** menu (see right) can be used to interactively create a curve T/HIS by selecting points using the mouse.



Start Curve

This option will start point selection process. Once you have started creating a curve all the other T/HIS menus will be disabled until you end the point selection using either the **End Curve** or **Quit Curve** options.

Dynamic viewing will still be available.

End Curve

This option will end the current curve creation and save the curve.

Quit Curve

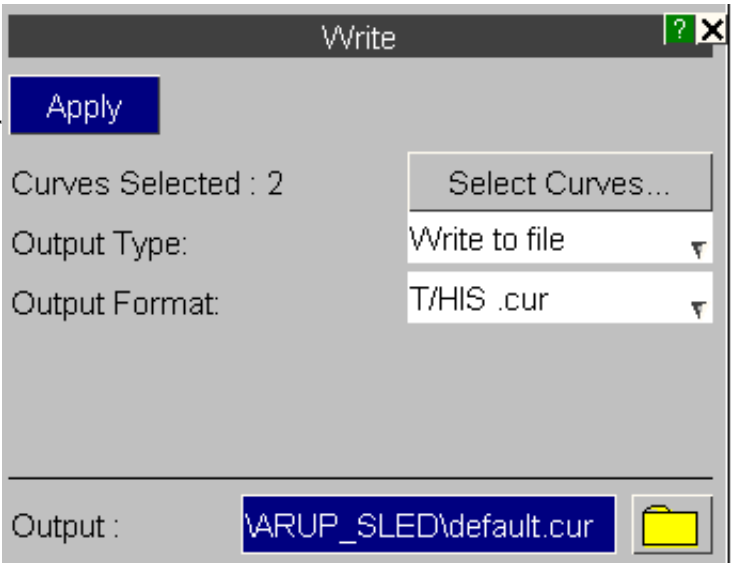
This option will end the current curve creation without saving the curve.

Undo Last

This option can be used delete the last point created (the middle mouse button will also delete the last point).

5.2 WRITE Options

Writes a group of curves out to a file for later use or to the screen.



5.2.1 WRITE TO FILE

Writes a group of curves out to a file for later use if required. The user is prompted for the list of curves to write out after a filename has been specified.

5.2.1.1 FILE FORMAT

Writes a group of curves out to a file for later use if required. The user is prompted for the list of curves to write out after a filename has been specified.



T/HIS .cur format

This option will write out curves using the default T/HIS curve format. One curve file will be written containing all the selected curves along with their Titles, Axis Labels, Line Labels and styles. From version 9.4 onwards the curve file can also contain information on the UNIT system and the X and Y axis units for each curve (see [Appendix B](#) for more details on the curve file format)

LS-DYNA Keyword

One file will be written containing all the selected curves using the LS-DYNA *DEFINE_CURVE format so that the file is suitable for inclusion in a LS-DYNA keyword file.

NASTRAN D1

This option will write out curves using the NASTRAN TABLE D1 format. Curves are listed sequentially in the file.

CSV X.Y.X.Y.X.Y

This option will write out curves using as a CSV (comma separated variable) file that can be read into other programs like Microsoft EXCEL. The columns written are x-values for the 1st selected curve, y-values for the 1st selected curve, x-values for the 2nd selected curve, y-values for the 2nd selected curve ...

CSV X,Y,Y,Y,Y,Y

This option also writes out a CSV file. All the curves are output using a single consistent set of X values that can either be taken from one of the curves or they can be generated automatically.

Summary

Gives a summary of the curve. This includes the type of data being plotted and the maximum and minimum values in the curve.

From version 9.4 onwards the CSV files generated by T/HIS can also contain information on the UNIT system and the X and Y axis units for each curve. If you don't want to output this information then you can turn it off.

The default setting for this option can be set via the preference option

this*write_csv_units:

This option can also be turned on and off in FAST-TCF scripts (see section 7.XX)

5.2.2 WRITE TO SCREEN

Writes data to a text window on the screen.

5.2.2.1 OUTPUT FORMAT

List
Summary
Scan

LIST

This option will write out all the points in the selected curves.

Summary

Gives a summary of the curve. This includes the type of data being plotted and the maximum and minimum values in the curve.

SCAN

Scans a group of curves and reports the maxima and minima values for each individual curve along with the overall maxima and minima

5.3 Curve Manager

In screen menu mode curves are managed using the **CURVE MANAGER** window, shown in the figure (right).

By default the **CURVE MANAGER** menu only displays 1000 curves. An unlimited amount of curves can be used and these are displayed in the menu in blocks of 1000. If an attempt is made to use a curve higher than 1000 then the Range options are used to select which group of 1000 curves you wish to display.

Against each curve that currently contains information is a curve number button. The colour of this button indicates the current blanking status of a curve

	The curve is unblanked in all active graphs (see section 3.5)
	The curve is blanked in all active graphs
	The curve is unblanked in some active graphs

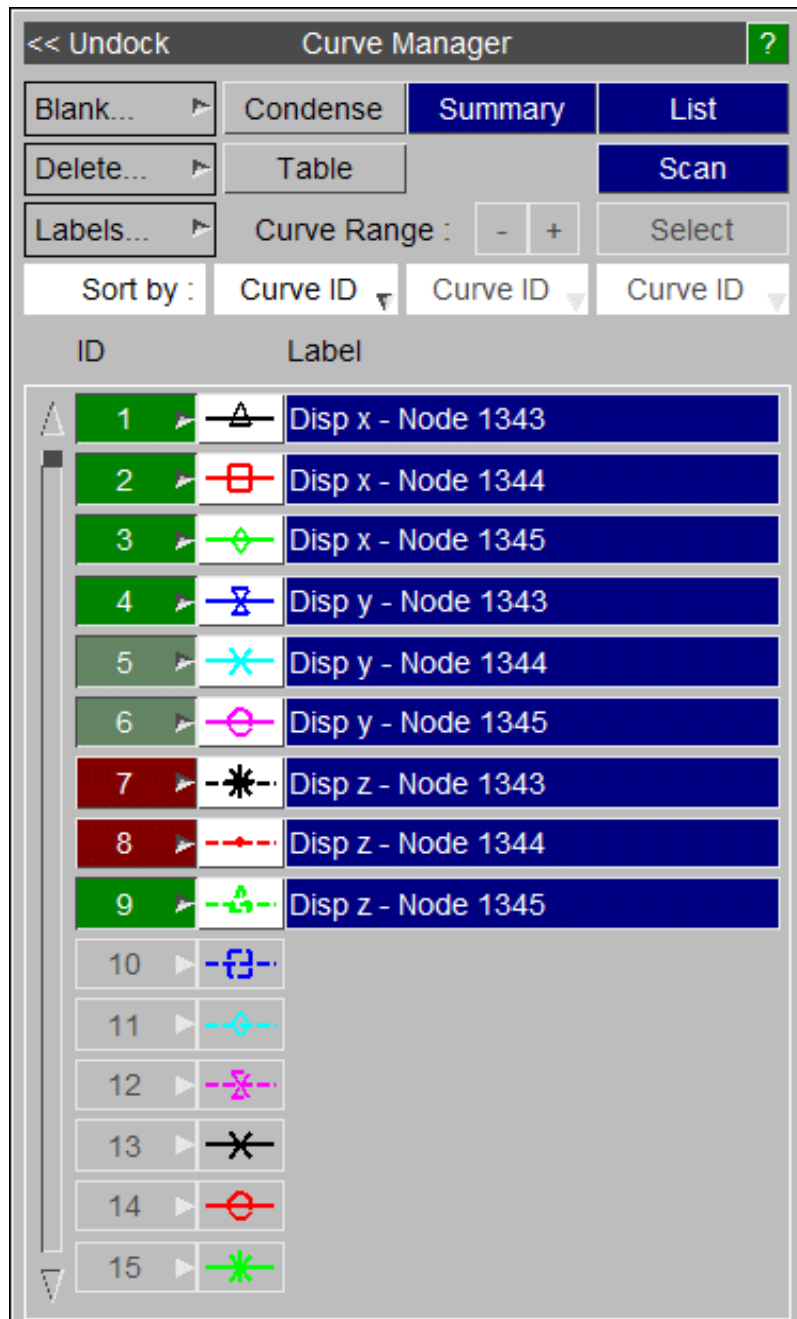
The blanking status of each curve can be changed by clicking on this button. The [Curve Table](#) can also be used to change the blanking status of a curve.

A range of curves may either be blanked or unblanked by selecting the first button in the range and then holding down the **SHIFT** key while selecting the last button in the range. All buttons that lie between the first and last buttons selected will have their status changed to match that of the first button that was selected.

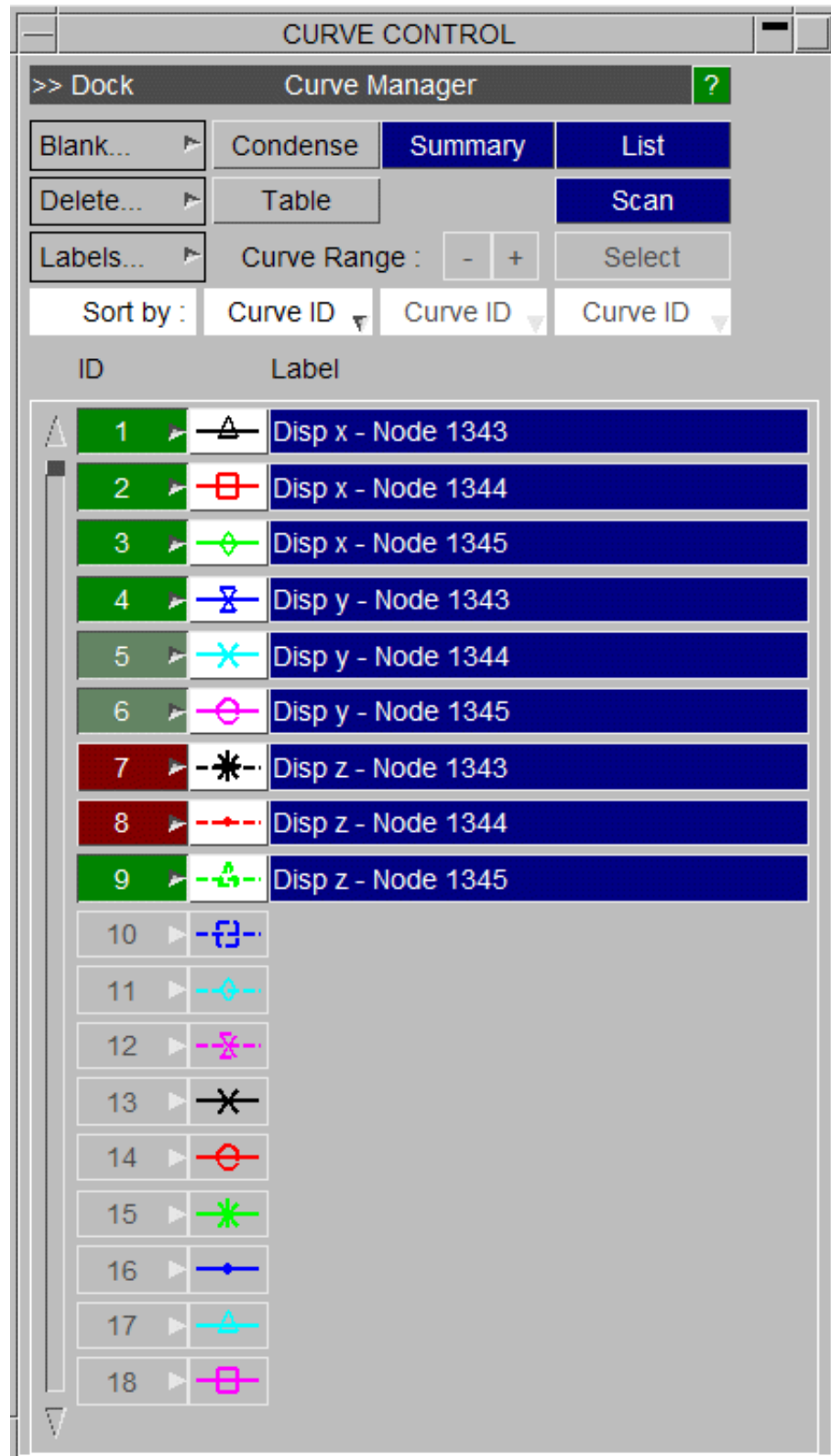
The line label for each curve may be changed by over-typing the label currently displayed in the line label box.

The button located between the curve number button and the curve label shows the current colour, line style and symbol that will be used to plot the curve. These properties can be modified by clicking on this button to display the line style menu, see [Section 5.6](#).

The **CURVE CONTROL** window can also be accessed via the **File....Curves** option at the top of the graphics window or from the **Curves** button in the main menu.

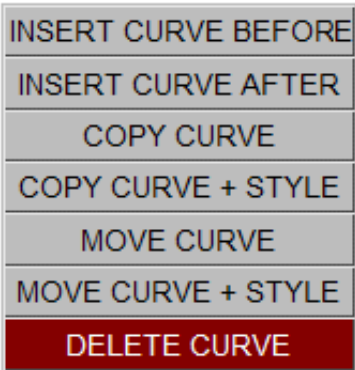


If the curve labels are too long to be seen in the standard Curve Manager menu then the menu can be turned into a floating menu by selecting the <<<Undock option in the menu header. After undocking the menu it can be re-docked by selecting >>>Dock.



5.3.1 Reordering Curves

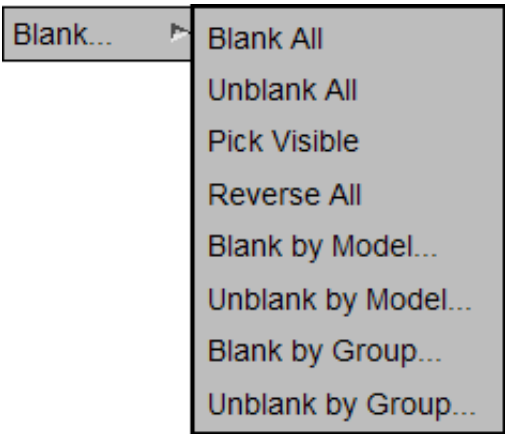
Attached to each of the curve number buttons is a popup menu that can be used to reorder curves by copying and moving them. This menu is accessed by clicking the right mouse button over the curve number buttons.



- INSERT CURVE BEFORE
- INSERT CURVE AFTER
- COPY CURVE
- COPY CURVE + STYLE
- MOVE CURVE
- MOVE CURVE + STYLE
- DELETE CURVE

- Inserts the last curve copies to a scratch definition before the selected curve.
- Inserts the last curve copies to a scratch definition after the selected curve.
- Copies the curve to a scratch definition.
- Copies the curve along with its line style settings to a scratch definition.
- Copies the curve to a scratch definition and then deletes the original curve
- Copies the curve along with its line style settings to a scratch definition and then deletes the original curve
- Deletes the selected curve

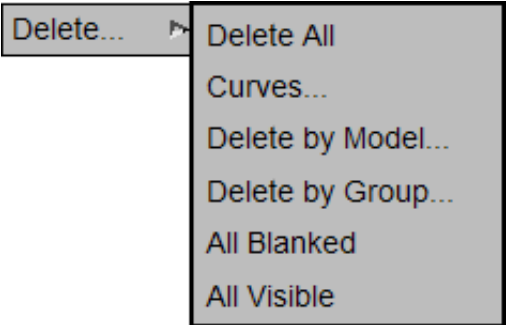
5.3.2 Blank...



- Blank All
- Unblank All
- Pick Visible
- Reverse All
- Blank by Model...
- Unblank by Model...
- Blank by Group...
- Unblank by Group...

- Blank all curves
- Unblank all curves
- Pick curves from the screen to be blanked.
- Reverse the blanking status of all curves
- Blank curves belonging to a Model
- Unblank curves belonging to a Model
- Blank curves by Curve Group
- Unblank curves by Curve Group

5.3.3 Delete...



Delete All

Select a groups of curves for deletion

Curves...

Deletes all current curves. You are prompted for confirmation first!

Delete by Model...

Delete curves belonging to a Model

Delete by Group...

Delete curves by Curve Group

All Blanked

Delete all the curves that are currently blanked

All Visible

Delete all the curves that are currently unblanked

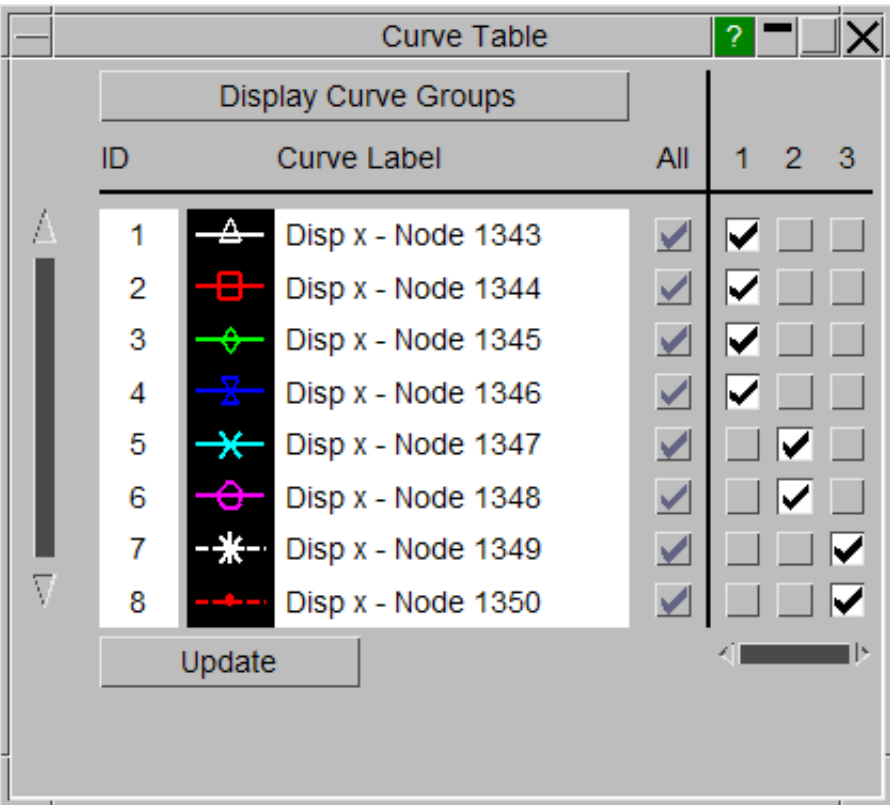
5.3.5 Table

The Table option can be used to give more control over which curves are blanked and unblanked in all of the currently defined graphs.

By default the Curve Table displays a scrolling list of all of the currently defined curves along with a set of tick boxes that display the status of the curve in the current graphs.

Multiple curves can be blanked/unblanked from one or more graphs by selecting the first curve/graph combination and then using SHIFT to select the the second.

In addition to adding a curve to a single graph the **All** option can be used to add a curve to all of the current graphs.

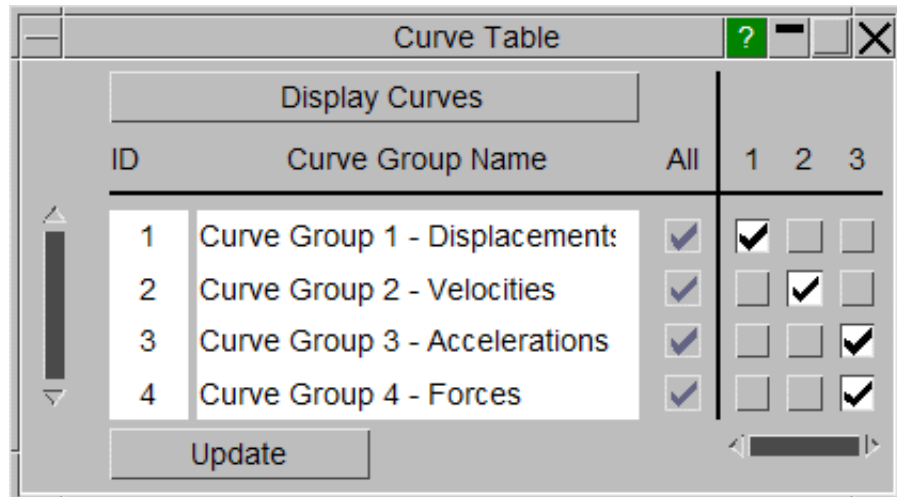


In addition to displaying a list of curves the Curve Table can also be used to display a list of curve groups.

If all of the curves in a group are unblanked in a graph then the tick box will display a black tick in a white box.

If some of the curves in a group are unblanked in a graph then the tick box will display a dark grey tick in a grey box.

If none of the curves in a group are unblanked in a graph then the tick box will be empty.



5.3.6 Summary

Displays a window from which a group of curves may be chosen. The maximum and minimum values of the selected curves are then displayed.

5.3.7 List

Displays a **LIST CURVES** window, from which a number of curves may be selected. The data point values for the selected curves are then listed in a listing box.

5.3.8 Scan

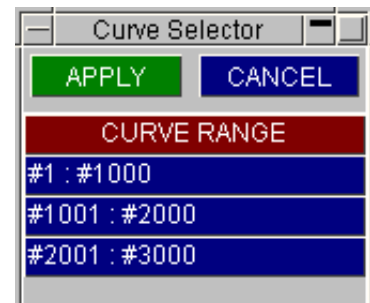
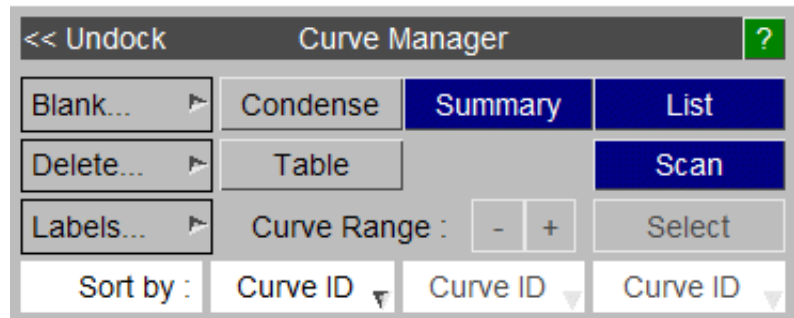
Displays a window from which a group of curves may be chosen. The maximum and minimum values of the selected curves are then displayed.

5.3.9 CURVE RANGE SELECTION

The range buttons in the Curve Control menu can be used to when you are working with more than 1000 curves to move between groups of 1000 curves. Pressing the green + tab will display the next group of 1000 curves in the menu, whilst pressing the red - tab will display the previous group of 1000 curves.

Alternatively pressing the Select button will bring up the following new window.

Select the appropriate group of 1000 curves and press apply to display those 1000 curves in the Curve control menu.



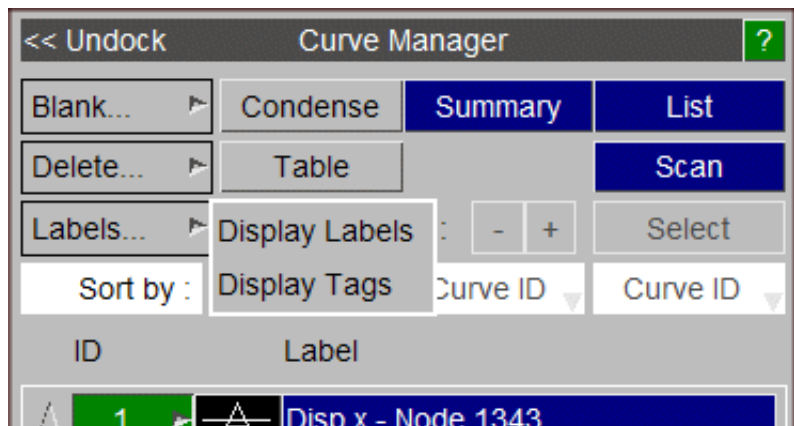
5.3.10 CURVE TAGS

Curves can be given tags to act as internal identifiers within T/HIS which can be used to reference curves in order to perform operations on them.

In order to display the curve tags, toggle on the Show Labels arrow and select Show Tags. The tag names can be defined in the input boxes.

When a curve file is written, T/HIS will save the tags of all the tagged curves in the file.

When performing operations in the dialogue box, curves can be referenced by their tags. The tag must be placed in double quotes.

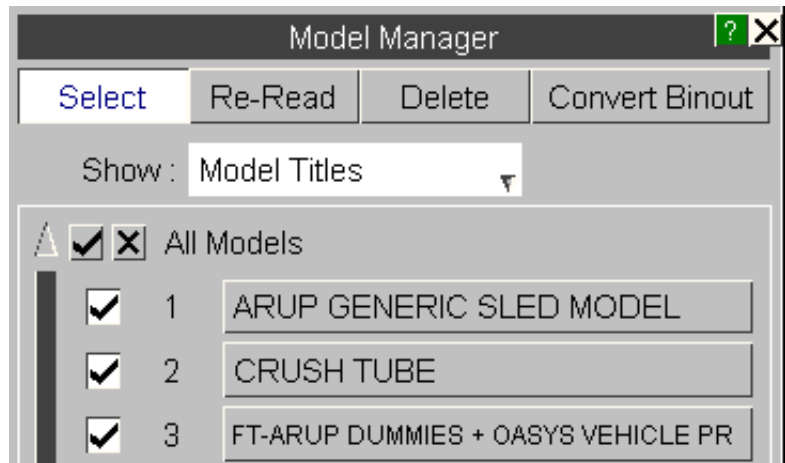


```
Operate > dif "Vel_x_n_123" #2050
(Written [Analysis Velocity (Dif)] to curve #2050)
(DIF #1002 => #2050)
```

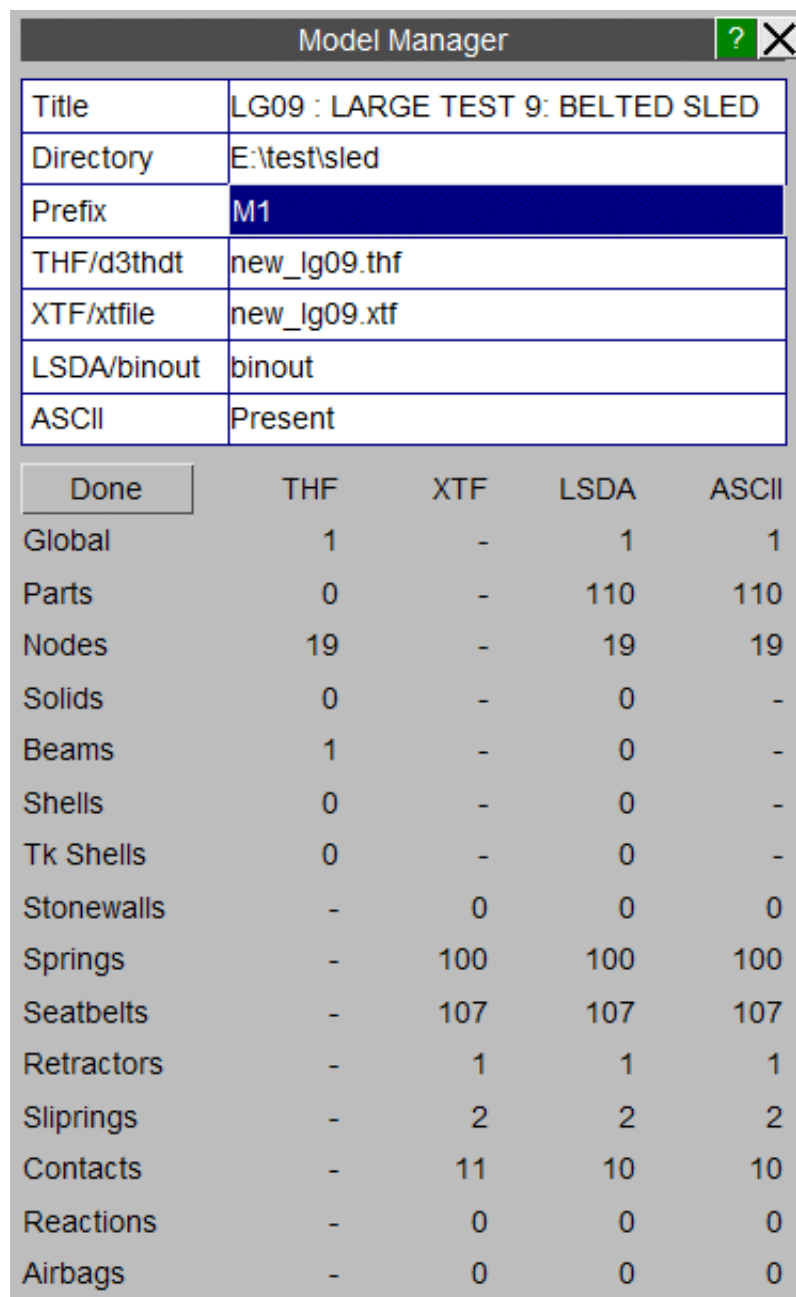
5.4 Model Manager

5.4.1 Select

This allows the user to turn models on/off. Deselecting a model will result in removal of its entities as options when reading data. Models can be displayed according to their titles or alternatively by the directories they were read in from.

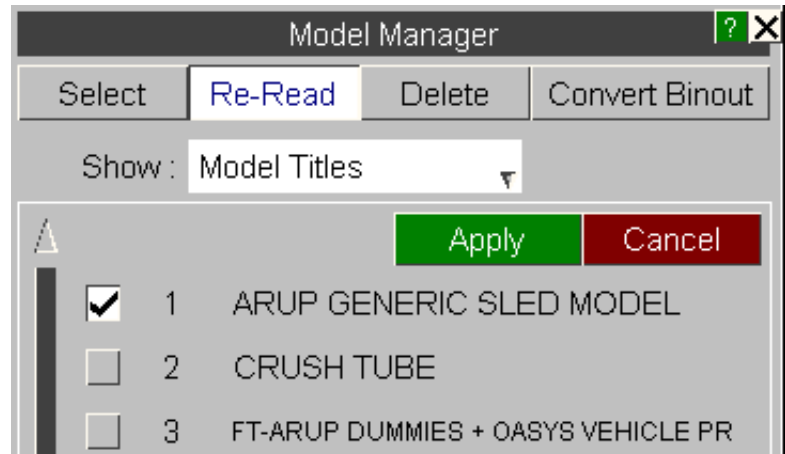


Clicking on the button displaying a model title will produce a menu similar to that illustrated. The number of each type of item in the model and the sources T/HIS found for that item type's data will be shown. The user can select which file type is preferred for the data for each type of item (see [Preferences](#)).



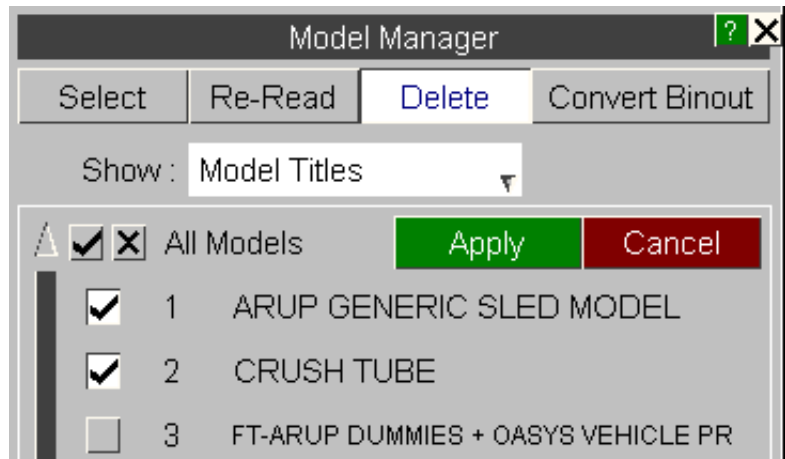
5.4.2 Re-Read

The re-read option can be used to rescan and update the model. This will find any new data written to disk since the file was last read.



5.4.3 Delete

This option allows the user to select and delete models from T/HIS. Any curves that have been read in from a model that is deleted are NOT deleted with the model. Any number of models to be deleted from T/HIS.

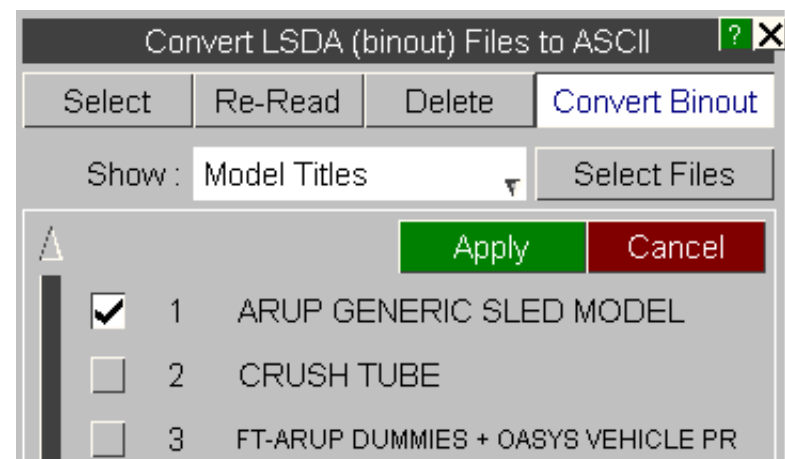


5.4.4 Convert Binout

This option can be used to convert LSDA binout files into the older ASCII files. The menu allows a number of models to be selected.

The **Select Files** button allows the user to specify which ASCII files are to be created.

All of the ASCII files are written into the directory containing the LSDA file.



5.5 EDIT Options

This menu allows you to examine and make modifications to the curve data points. You are always working on a "scratch" copy of the curve. The permanent curve is only updated when you SAVE it explicitly.

Moving around the curve data is done through the use of scroll bars on the data panel.

Save

Saves the edited curve as either a new curve or overwrites the original.

Restart

Resets the curve being edited to the values at the start of the edit session.

Quit

Quits the curve editor without making any changes to the curve

Labels...

Allows the title, axis and line label to be changed (see [Section 5.5.3](#) for more details)

Replace

Allows curve values to be changed by overtyping the x and y values.

Insert Before

Inserts a new point in the curve before the selected point.

Insert After

Inserts a new point in the curve after the selected point.

Delete

Deletes the selected point.

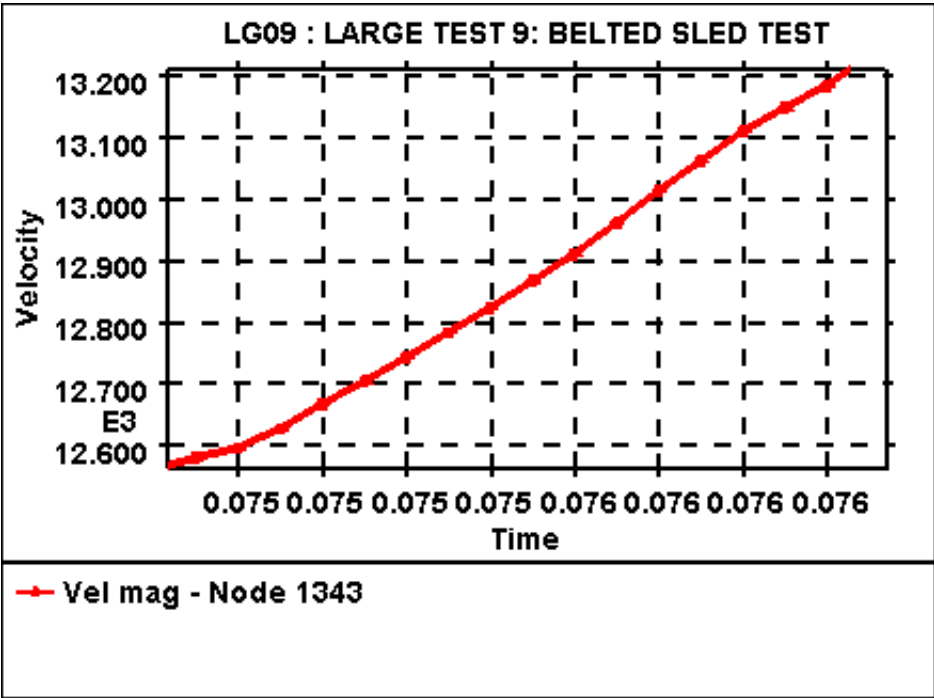
The screenshot shows the 'Curve Editor' window with a menu bar containing 'Save', 'Restart', 'Quit', and 'Labels...'. Below the menu bar are buttons for 'Replace', 'Insert Before', 'Insert After', and 'Delete'. A status bar shows '#points: 1001' and a 'Command:' field. The main area is a table with columns 'Point', 'X value', and 'Y value'. The table contains 22 rows of data. A vertical scroll bar is on the left of the table.

Point	X value	Y value
1	0.000000E+00	0.000000E+00
2	9.940239E-05	1.035303E+00
3	1.977450E-04	2.124691E+00
4	2.990677E-04	3.401202E+00
5	3.974104E-04	4.798676E+00
6	4.987331E-04	6.375494E+00
7	5.970757E-04	7.994342E+00
8	6.983984E-04	9.703846E+00
9	7.997211E-04	1.141409E+01
10	8.980638E-04	1.304722E+01
11	9.993864E-04	1.468456E+01
12	1.097729E-03	1.621935E+01
13	1.199052E-03	1.773808E+01
14	1.297394E-03	1.914959E+01
15	1.398717E-03	2.054395E+01
16	1.497060E-03	2.185106E+01
17	1.598382E-03	2.316937E+01
18	1.699705E-03	2.448088E+01
19	1.798048E-03	2.576451E+01
20	1.899370E-03	2.710555E+01
21	1.997713E-03	2.841944E+01
22	2.099036E-03	2.976754E+01

The **Command** text-box allows control by command line (see [Section 5.5.2](#) for more details).

5.5.1 Interactive Curve Editing

After a curve has been selected it is displayed using a thicker line to highlight it in any graphs that it is visible in.



As well as being highlighted the curve points can be edited interactively and the Quick Pick menu in the main Tool Bar (see [Section 6.1](#) for more details) is replaced with the EDIT menu.

Modify (Drag X,Y) ▾

Edit Points

Modify (Drag X,Y) ... ▾

Insert (Between) ... ▾

Delete (Point) ... ▾

Locate

Restart

Save (Overwrite)

Save (Highest used + 1)

Quit

5.5.1.1 Modify

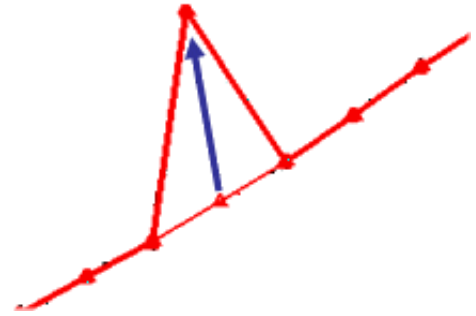
Modify (Drag X,Y) ... ▾

Drag X,Y

Drag X

Drag Y

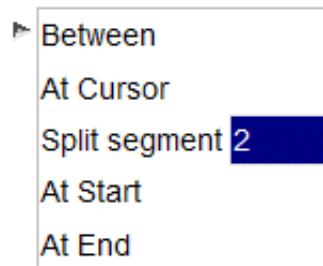
Drag X,Y Modify the point nearest to the screen pick by dragging it's position in both the X and Y axis directions.



Drag X Drag a point in the X axis direction only.

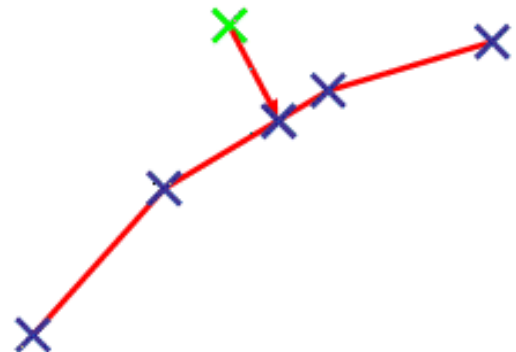
Drag Y Drag a point in the Y axis direction only.

5.5.1.2 Insert **Insert (Between) ...**



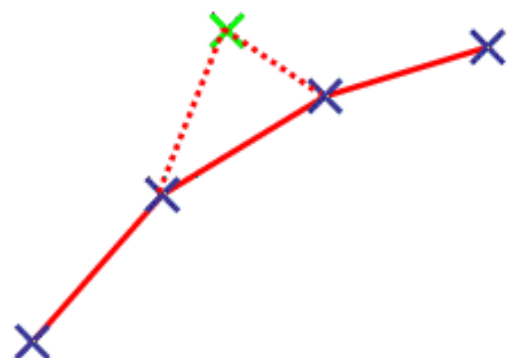
Between

Finds the nearest segment to the point selected on the screen and then projects the point onto the segment.



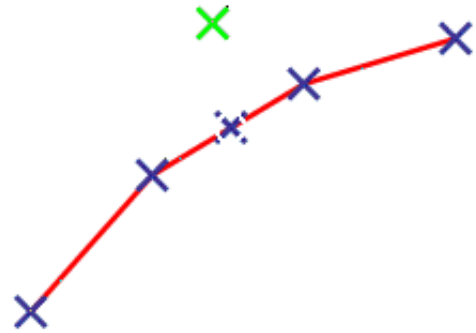
At Cursor

Finds the nearest segment to the point selected on the screen and then inserts the a point at the screen location between the 2 ends of the segment.



Split Segment

Finds the nearest segment to the point selected on the screen and then splits the segment in 2 or more parts.

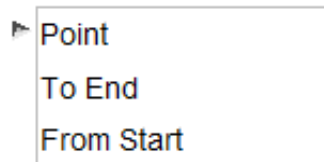
**At Start**

Inserts a new point at the screen location before the first point in the curve.

At End

Inserts a new point at the screen location after the last point in the curve.

5.5.1.3 Delete **Delete (Point) ...**

**Point**

Finds the nearest point to the screen pick and deletes it.

To End

Finds the nearest point to the screen pick and deletes all points in the curve from that point onwards.

From Start

Finds the nearest point to the screen pick and deletes all points in the curve up to that point.

5.5.1.4 Locate

Finds the nearest point to the screen pick and updates the list of points in the main edit panel so that the points either side of the picked point are displayed.

5.5.1.5 Restart

Resets the curve being edited to the values at the start of the edit session.

5.5.1.6 Save (Overwrite)

Overwrite the original curve with the edited one.

5.5.1.7 Save (Highest used + 1)

Save the edited curve as a new curve without overwriting the original curve.

5.5.1.8 Quit

Quits the curve editor without making any changes to the curve.

5.5.2 Command line mode

In command line mode editing of curves is done in a similar fashion using the following commands.

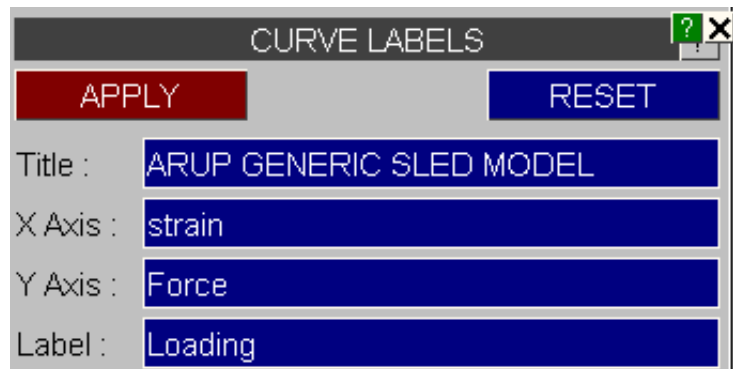
Moving around the curve:	F	Forward	Move forward 16 lines
	B	Back	Move back 16 lines
	T	Top	Move to the top of the curve
	E	End	Move to the end of the curve
	N	Number	Move to given line number
Modifying the curve:	Cn	Change	Change line n
	In	Insert	Insert points before line n
	An	Append	Append points after line n
	D n1 n2	Delete	Delete lines n1 to n2
	L	Label	Change the line label
	R	Reset	Reset the curve back to the original curve
Saving and Plotting the curve:	W	Write	Write the curve
	S	Save	As write
	PE	Plot Edited	Plot the edited curve
	PA	Plot All	Plot the edited and original curve
	PL	Plot	Plot the current T/HIS curves
	Q	Quit	Quit the editor

In command line mode the EDIT menu is reached by typing **/ED**

5.5.3 Curve Labels

Each curve has four labels associated with it:

Title	The title string at the top of the plot
X label	The label for the X axis of the plot
Y label	The label for the Y axis of the plot
Label	The label applied to the line itself



The first three are only used on a plot if this curve is the first (or only) curve to be plotted, and the relevant labels are in "automatic" mode (see [TITLE and AXIS](#)).

You can change any of these by simply overtyping whatever is currently there. When you are happy with the result use the **APPLY** button to dismiss this box, saving the new values. The labels here are scratch values, current only in this editor, the permanent curve labels are only overwritten with them if you **SAVE** this edited curve.

RESET will restore the scratch labels to the original values of the permanent curve being edited.

The title, axis and line labels can also be modified using the [dialogue box](#)

5.6 LINE STYLES

The **LINE STYLE** menu is shown in the figure (right). This menu can be used to change the colour, width, style and symbol for any of the curves that are currently being used.

When a curve file is written, T/HIS will save the line style for each curve in the file.

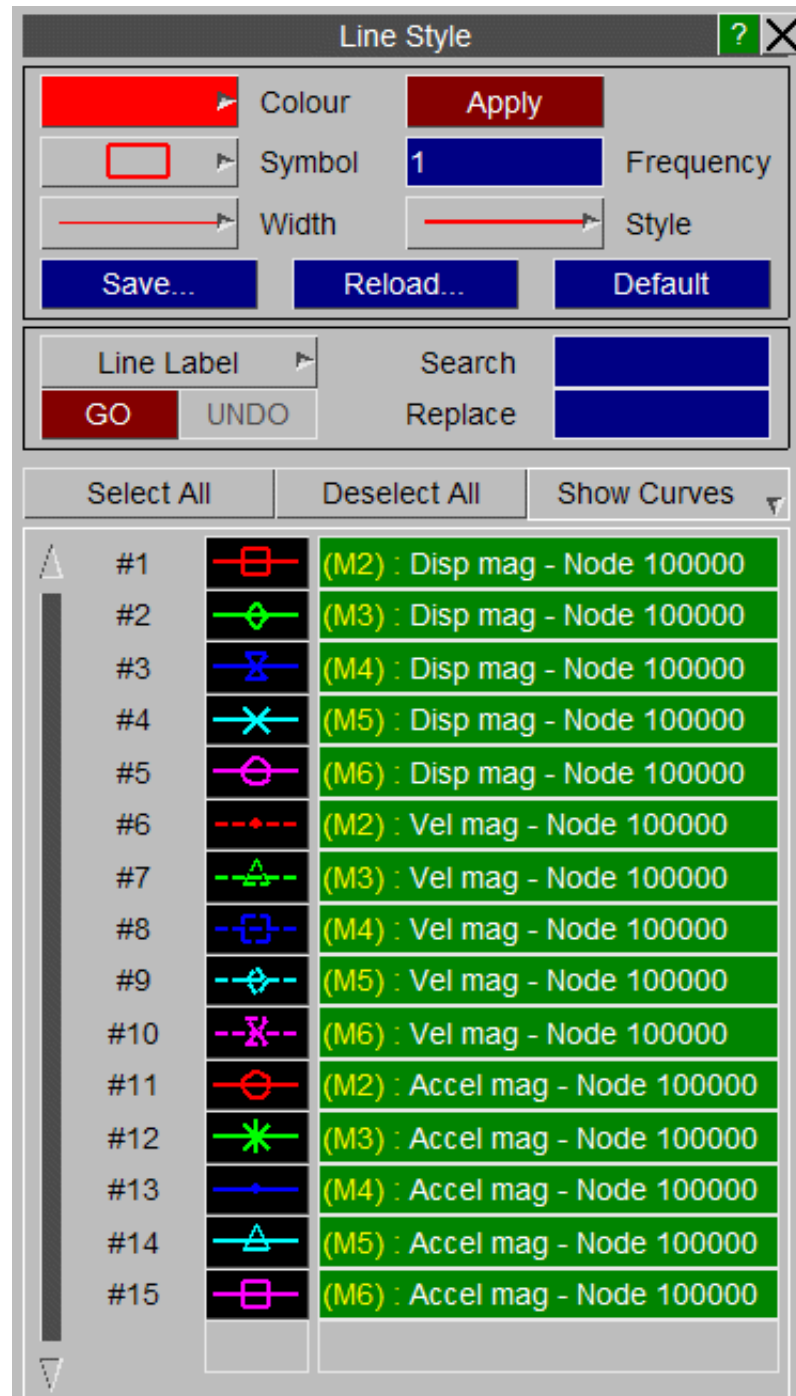
The lower half of this panel contains a list of all the curves that are currently being used. By default the curve that was clicked on in the **CURVE CONTROL** menu will be highlighted and the colour and symbol buttons in the top section of the menu will show the setting for that curve.

The **SAVE...** button can be used to save the current set of line styles to a file while the **RELOAD...** button can be used to reload a set from a previously saved file. The **DEFAULT** button will reset all the curve styles to the original T/HIS settings.

If you wish to modify the colour/style of more than one curve at a time additional curves may be selected by pressing the button next to each curve number that depicts the current line style.

SELECT_ALL and **DESELECT_ALL** may be used to select/deselect all the curves.

Line Styles can also be edited using the [dialogue box](#)



5.6.1 APPLY

This button will **APPLY** the current line colour, symbol, width and style selection to all the curves that have been selected.

5.6.2 COLOUR

Pressing the right mouse button while over the colour button will invoke a colour popup menu.

T/HIS has a built in palette of 30 predefined colours and 6 user defined colours. Colours are defined using 6 digit Hexadecimal values using the format RRGGBB.

RR Red Component (0-255)
GG Green Component (0-255)
BB Blue Component (0-255)



Colour ID	Name	Alternative Name	Value
1	COL 1	WHITE	FFFFFF
2	COL 2	RED	FF0000
3	COL 3	GREEN	00FF00
4	COL 4	BLUE	0000FF
5	COL 5	CYAN	00FFFF
6	COL 6	MAGENTA	FF00FF
7	COL 7	YELLOW	FFFF00
8	COL 8	ORANGE	FF9C00
9	COL 9	TURQUOISE	21FF94
10	COL 10	INDIGO	7B00FF
11	COL 11	LIME	BDF39
12	COL 12	SKY	39BDF3
13	COL 13	PINK	FF7B7B
14	COL 14	BLACK	000000
15	COL 15	-	393939
16	COL 16	-	7B7B7B
17	COL 17	-	BDBDBD
18	COL 18	-	FFF9C
19	COL 19	-	FFCE00
20	COL 20	-	7B7B00
21	COL 21	-	9C3163
22	COL 22	-	9CCE00
23	COL 23	-	7B7BFF
24	COL 24	-	FF9CCE
25	COL 25	-	FFCE9C
26	COL 26	-	317B63
27	COL 27	-	7B0000
28	COL 28	-	007B00
29	COL 29	-	7B007B
30	COL 30	-	00007B
31	COL 31	USER 1	-
32	COL 32	USER 2	-
33	COL 33	USER 3	-
34	COL 34	USER 4	-
35	COL 35	USER 5	-
36	COL 36	USER 6	-

As well as the 36 colour options **Foreground** and **Background** can be selected to change the colour to the **Foreground** and **Background** colours defined in the [Display](#) menu.

If **N/C** is selected then the **Apply** button will have no effect on the colour of the currently selected curves..

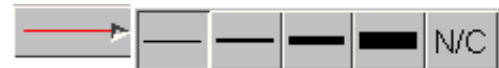
5.6.3 SYMBOL



Pressing the right mouse button while over the **Symbol** button will invoke a symbol popup menu that allow any of the 9 T/HIS symbols to be selected (the 9th is a blank symbol that can be selected so that a curve can be plotted without a symbol). As well as the 9 symbols the menu also contains a no change (**N/C**) option.

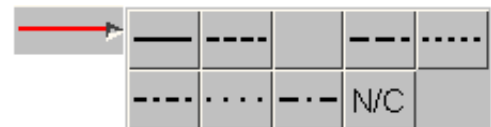
The **Symbols Frequency** controls how often a symbol is drawn on a curve. By default, symbols are not drawn; they can be switched on using the [Display](#) menu.

5.6.4 WIDTH



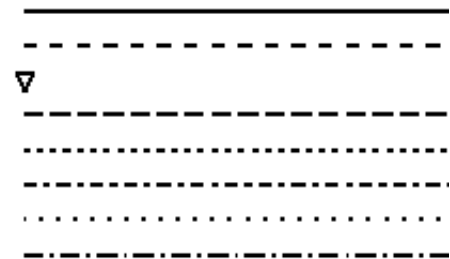
Pressing the right mouse button while over the width button will invoke a popup menu that allows 4 different line widths to be selected or no change (**N/C**).

5.6.5 STYLE

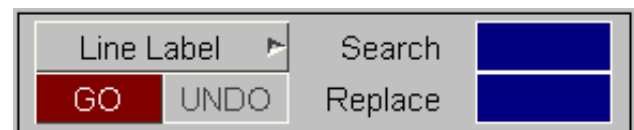


Pressing the right mouse button while over the style button will invoke a popup menu that allows 8 different line styles to be selected (the 3rd is actually a blank line that can be selected so that a curve can be plotted without a line).

As well as the 8 line styles the menu also contains a no change (**N/C**) option.



5.6.6 MODIFYING LABELS



Multiple curve labels may be edited using the Search and Replace option to enter the string to search for and the string to replace it with. **^** can be used to insert text at the beginning of a label while **\$** can be used to append to the end of a label. The table below shows the effect of 2 search and replace examples.

	Example 1	Example 2
Original Label	Displacement N1034	Time
Search String	N1	\$
Replace String	Node 1	(s)
Modified Label	Displacement Node 1034	Time(s)

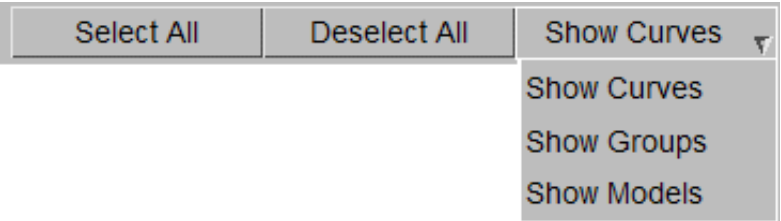
The **GO** button will initiate the search and replace on all the curves that are currently selected (highlighted in the bottom half of the menu), while the **UNDO** button can be used to reset the labels to what they were before the search and replace.

Pressing the right mouse button while over the **Line Label** button will invoke a popup menu that allows the label that is being modified to be swapped between the **Line Label**, **X-Axis Label** and the **Y-Axis Label**.

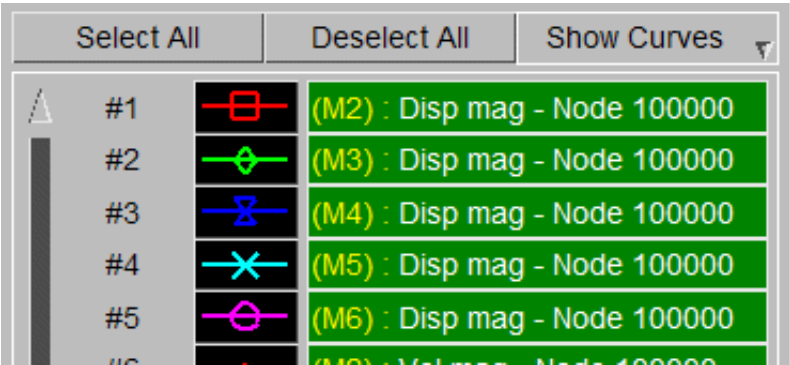
Line labels can also be modified by using the [dialogue box](#)



5.6.7 **SELECTING CURVES**

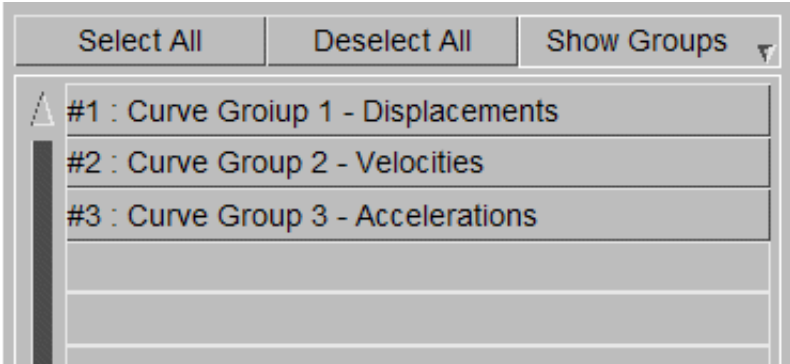


By default the Style menu will display a list of all the current defined curves so that the style for individual curves can be



Instead of displaying individual curves the style menu can be changed to display a list of any currently defined curve groups.

If curve groups are selected then the style will be applied to all of the curves in the curve group.



The style menu can also display a list of all the models currently loaded in T/HIS.

If models are selected then the style will be applied to any curve that was created using data from the model.



5.6.8 LINE STYLE EDITING IN THE DIALOGUE BOX

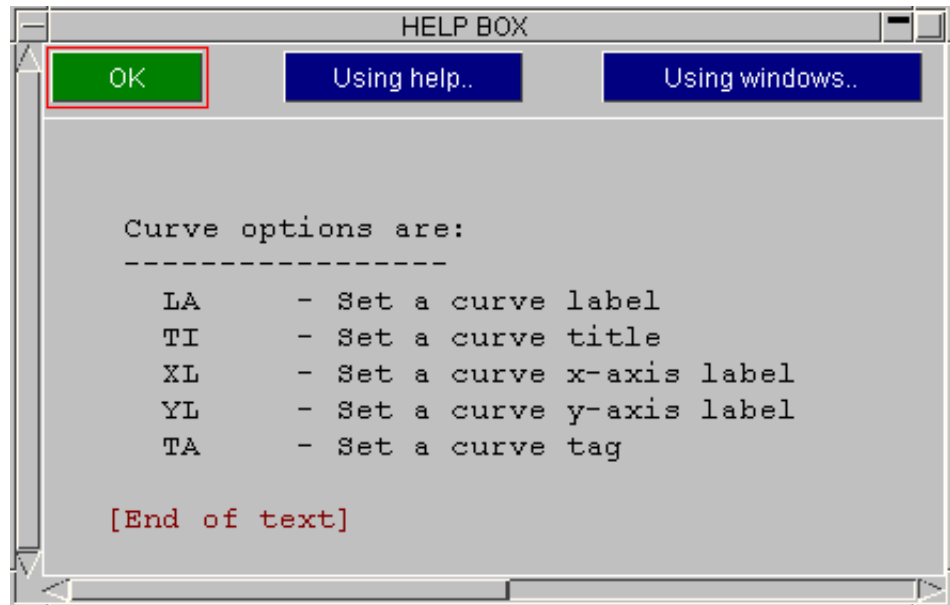
The dialogue box can be used to edit curve styles

To access this feature, enter the command /style at the Command prompt

Enter M at the STYLE > command prompt for a list of all available dialogue box commands

The following commands are available:

SET
READ
WRITE
DEFAULT
FIX
GM



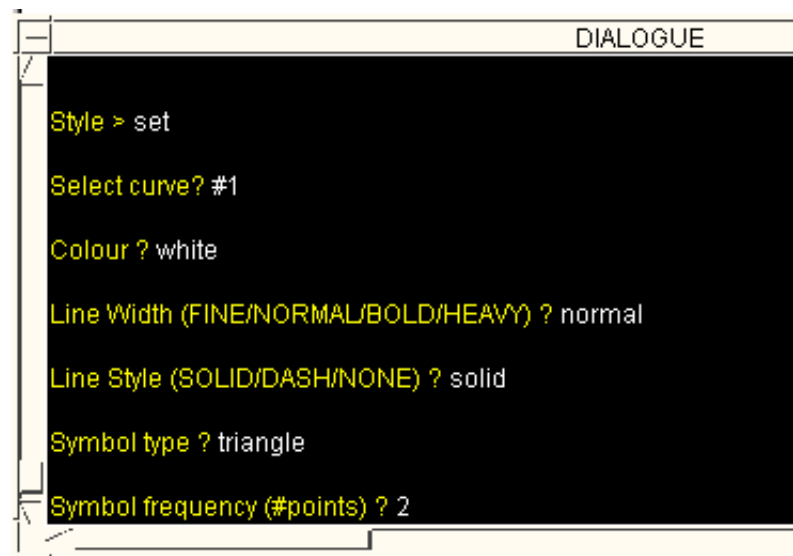
SET

This option allows the user to set the style properties for individual curves.

Enter the curve number (e.g #1 for curve 1) at the Select Curve? command prompt.

T/HIS will prompt the user to input the desired style properties in the order:

Colour; Enter the colour for the line
Line Width; Enter the desired line width for the line
Line Style; Enter the desired line style (e.g. dashed) for the line
Symbol Type; Enter the desired Symbol Type
Symbol Frequency; Enter the desired frequency of the symbols in the format



READ

This option allows the user to read a style file containing style information and apply that style to a particular curve

Enter the name of the style file at the Style File? command prompt.

WRITE

This option allows the user to write a style file containing style information.

DEFAULT

This option allows the user to reset all the curve styles to the default settings.

FIX

This is an **ON/OFF** switch which resets the curve styles when they are plotted on the screen so that the curves cycle through the default T/HIS colours and styles as they are plotted. This will result in the first curve being plotted always being white, the second red, the third green, etc regardless of their curve numbers. The default is **OFF**.

GM

This option will display the Global Menu in a separate window

5.6.9 LABEL AND TITLE EDITING IN THE DIALOGUE BOX

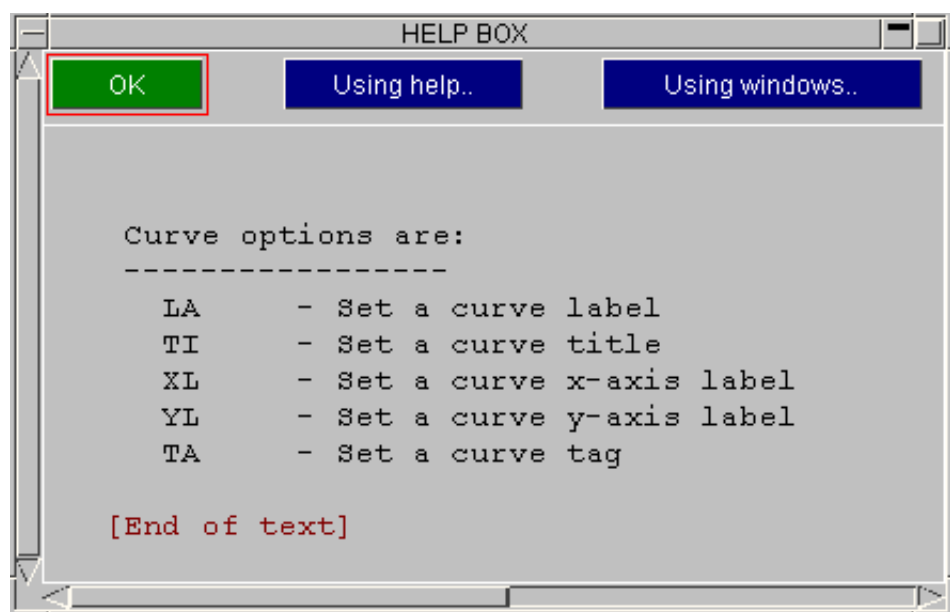
The dialogue box can be used to edit curve labels, x-axis and y-axis labels and curve titles

To access this feature, enter the command /cur at the Command prompt

Enter M at the CURVE > command prompt for a list of all available dialogue box commands

The following commands are available:

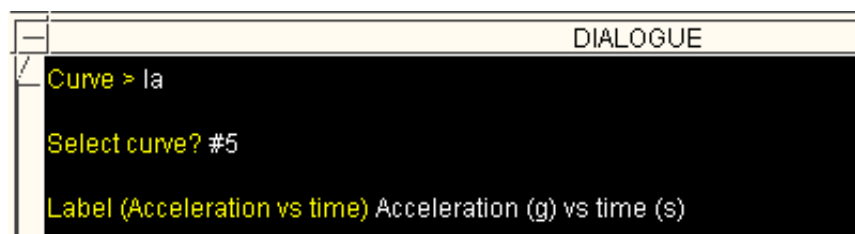
LA
TI
XL
YL
TA

**LA**

This option allows the user to edit the label for individual curves.

Enter the curve number at the Select curve? prompt

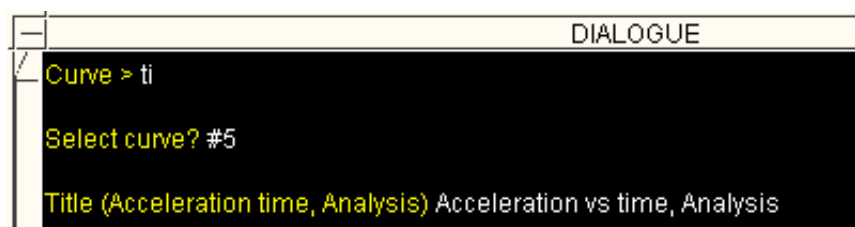
Enter the desired new label at the Label prompt, The current Label will be displayed in brackets

**TI**

This option allows the user to edit the title for individual curves.

Enter the curve number at the Select curve? prompt

Enter the desired new title at the Title prompt, The current title will be displayed in brackets

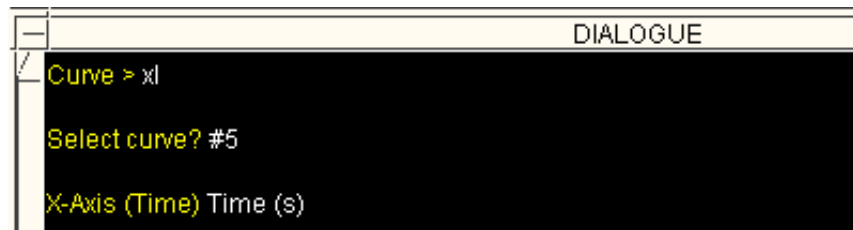


XL

This option allows the user to edit the x-axis label for individual curves.

Enter the curve number at the Select curve? prompt

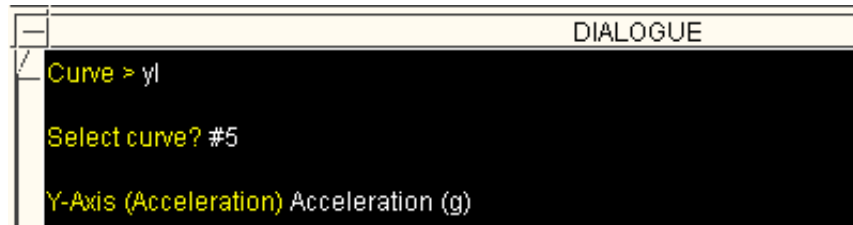
Enter the desired new title at the X-Axis prompt, The current x-axis label will be displayed in brackets

**YL**

This option allows the user to edit the y-axis label for individual curves.

Enter the curve number at the Select curve? prompt

Enter the desired new title at the Y-Axis prompt, The current y-axis label will be displayed in brackets

**TA**

This option allows the user to edit the tag for individual curves.

Enter the curve number at the Select curve? prompt

Enter the desired new Tag at the Tag prompt, The current tag will be displayed in brackets



5.7 Command / Session Files

Command and session files are used to drive or record a T/HIS session. Both session (save) and command (playback) files have been set up to act like tape recorders; and the concept of "recording" and "playing back" files will be used below.

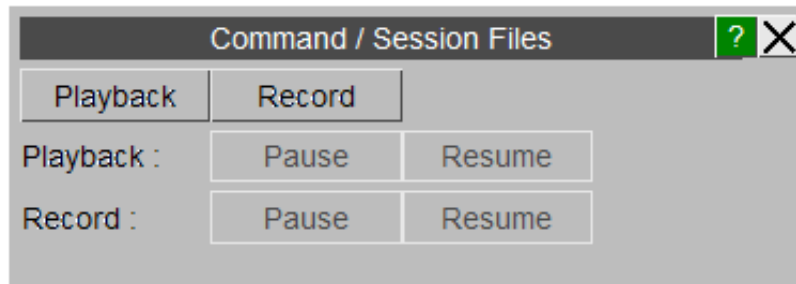
These files ("button click" command files) are not easy to edit by hand and they are not always backwards compatible between versions of T/HIS. For these reasons most users prefer the new [FAST-TCF](#) format, which can also be recorded and [played back](#) from within T/HIS.

In screen menu mode a command has a meaning beyond the simple command word. For example, **HELP** appears in many different places, with a distinct meaning (or relevance) in each place. Therefore, context information is stored when saving screen menu session files.

In practice the following information is saved:

- the command itself - whether typed or inferred from a button
- the button identification (if any)
- the parent window identification
- the menu item (if relevant)
- the action type (screen pick, button press, etc)
- any x/y coordinates that may be relevant.

A choice of either writing ("recording") session files or executing ("playing back") command files is given. By default commands are not saved. If they are to be saved the session file record switch must be turned on.



5.7.1 Writing ("Recording") Session Files

To write a session file the record **CONTROLS...** button must be pressed, displaying the **RECORD COMMAND FILES** menu shown right.

Pressing the **RECORD >** button will start the session file. Thereafter, all commands (except those in the session/playback windows) are saved in an internal scratch file. In order to save these commands to disk they must be written explicitly using the **SAVE TO DISK** button. They can then be read back in and replayed

A variety of features are available to help move around the file. These are shown in the **FILE POSITION AND CONTROL** area of the panel. The file can be indexed at particular user defined points using the **INDEX MARKS** menu is accessed by pressing the **INDEX...** button. These may be used as targets of a search and also to control recording.

The scratch file is random access, and can be moved back and forth and reviewed at will. To help with this it is possible to switch between **RECORD** and **REVIEW** modes in the session file control box:

RECORD records all your commands when running

REVIEW plays back your recorded commands

A command file can be stepped through or run backwards or forwards. It may also be searched for a particular command. As with a real tape recorder, if the pointer is moved backwards and recording continued the commands that were previously stored will be overwritten from that point.

The session file recording and command file playback operations are totally separate: they can be thought of as two separate tape recorders. As a consequence it is possible to record commands that are being played back: in effect it is possible to edit and combine files.

5.7.2 Executing ("Playing Back") Command Files

As above, the **PLAYBACK COMMAND FILES** menu, shown right, must be invoked from the **COMMAND/SESSION FILES** window.

This is done by pressing the playback **CONTROLS...** button. An existing file must then be read. This is analogous to loading a tape into the tape recorder: it is then converted into an internal scratch format (random access, as above) and can be played back or previewed at will.

Once a file is read in either **PLAYBACK** or **PREVIEW** mode may be selected:

PLAYBACK actually executes the commands, **PREVIEW** simply lists them without executing them.

The file may be stepped through backwards or forwards at will, and searches made for commands. Playback commences at the current line when **PLAY** is pressed, so it is possible to skip unwanted commands or repeat a sequence.

As with **RECORD** above, index marks can be inserted, which may be used as targets of a search and also to stop playback.

Command / Session Files

Playback

Record

Playback :

Pause

Resume

Record :

Pause

Resume

Filename and mode

File:

E:\roger.tcf

☐ Preview mode

☐ Playback mode

REREAD FILE

DELETE FILE

File position and control

<< SEARCH

PLAY >

SEARCH >>

< STEP

STOP

STEP >

TOP

Goto line:

END

INDEX...

SPEED...

ERRORS...

Current command status

Line no:

2 / 3

Box name:

Top menu box

Function:

Button Press

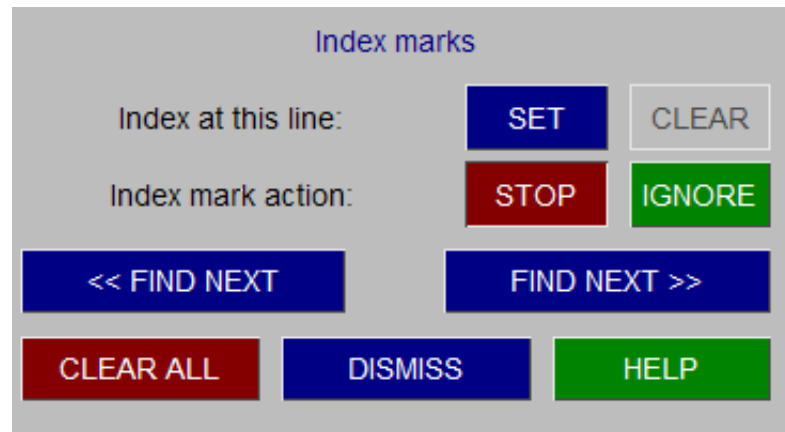
Command:

Command File

5.7.3 INDEX MARKS

"Index marks" are optional flags that you can set at any line in a file. They are not interpreted as commands but rather treated as markers which are used as targets of [SEARCH](#) operation. Index mark functions are:

SET	Set an index mark on this line;
CLEAR	Clear an index mark set on this line
STOP	Stop in PLAY/REVIEW mode when index found
IGNORE	Ignore index marks during PLAY/REVIEW
FIND INDEX	Finds the next index mark: "<<" searching backwards, ">>" searching forwards
CLEAR ALL	Clear all index marks in the file

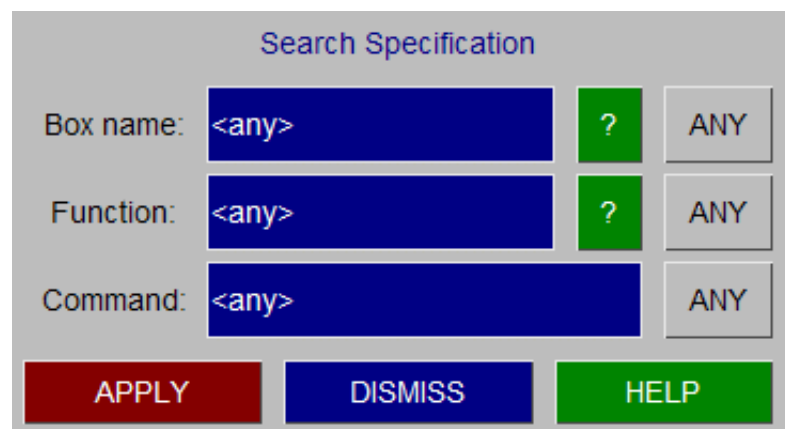


5.7.4 SEARCH

The **SEARCH** buttons can be used to find a specific command when in **REVIEW** mode. You can search through the command file for a match to any permutation of the following:

Box name	The name of a screen menu box inside' which an event occurred
Function	The screen menu function type. This is "button press", "dialogue", etc;
Command	The command word(s) to look for.

The default for all of these is "<any>", ie a wildcard search, but you can specify a value by typing into the appropriate text box. When you have filled in all the fields you need, press **APPLY** to start the search. "Box name" and "Function" fields are unlikely to be of use to most users, you can list all valid events using "?" button to provide a menu to pick from. The **ANY** button may be used for any field to restore it to its default (wildcard) status.



5.7.6 Command Line Mode Session / Command File Control

The available features in command line mode for command and session file control are very basic. A session file can be recorded at any point by typing **SF** (in the **GLOBAL MENU**) followed by the desired filename. This is equivalent to the **RECORD** button in screen menu mode. The session file can be closed by typing **CS** and is automatically written to disk. This is equivalent to pressing the **STOP** and **SAVE TO DISK** buttons in screen menu mode.

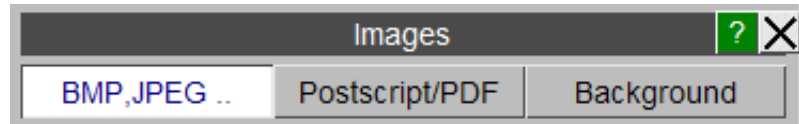
To execute an existing command file in T/HIS simply type **CF**, followed by the filename.

No previewing/reviewing or editing of command/session files is possible in command line mode.

5.7.7 Command Files From Earlier Versions Of T/HIS

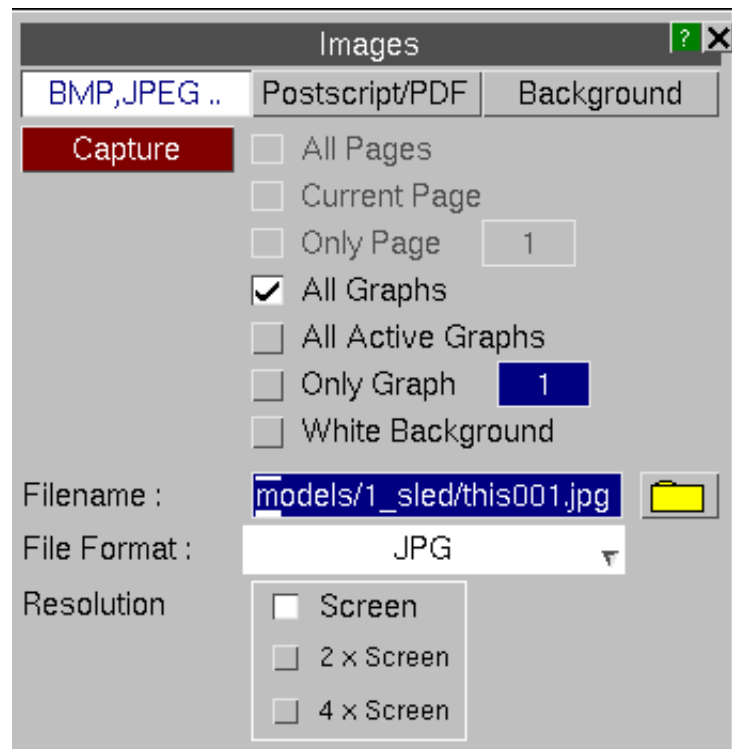
Command files recorded in Version 9.0 or earlier will not work in T/HIS 9.4.

5.8 IMAGE Options



5.8.1 BMP,JPEG ...

This menu can be used to save an image containing one or more graphs in a number of different formats.



All Pages

Each page will be saved as a single image to multiple files. The filenames used will be based on the filename selected by the user..

This option will only be available if T/HIS contains multiple graphs on more than one page ([see section 3.2](#)).

Current Page

A single image containing currently displayed page will be generated.

This option will only be available if T/HIS contains multiple graphs on more than one page ([see section 3.2](#)).

Only Page (n)

A single image containing the selected page will be generated.

This option will only be available if T/HIS contains multiple graphs on more than one page ([see section 3.2](#)).

All Graphs

A single image will be generated containing all of the graphs.

This option will only be available if T/HIS only contains a single page ([see Section 3.2](#)).

All Active Graphs

A single image will be generated containing all of the currently active graphs.

This option will only be available if T/HIS only contains a single page ([see Section 3.2](#)).

Only Graph (n)

A single image containing the selected graph will be generated.

White Background

Captures the image with a white background and black foreground. Once the image is captured the colours are reset to their original values.

5.8.1.1 File Format

8-bit file formats

BMP Uncompressed	Uncompressed 8 bit Microsoft windows bitmap. The approximate size of the file (in bytes) is file size= image width * image height
BMP Compressed	8 bit RLE Microsoft windows bitmap.
PNG	8 bit Portable Network Graphics
GIF	Graphics Interchange Format

24-bit file formats

BMP	Uncompressed 24 bit Microsoft windows bitmap. The approximate size of the file (in bytes) is file size = 3 * image width *image height
PNG	24 bit Portable Network Graphics
JPG	JPEG (Joint Photographic Experts Group) file
PPM	Uncompressed P ortable P ix M ap. The approximate size of the file (in bytes) is file size = 3 * image width *image height

8 bit BMP (Uncompressed) ▾

8-bit file formats

BMP (Uncompressed)

BMP (Compressed)

PNG

GIF

24-bit file formats

BMP

PNG

JPG

PPM

5.8.1.2 Resolution

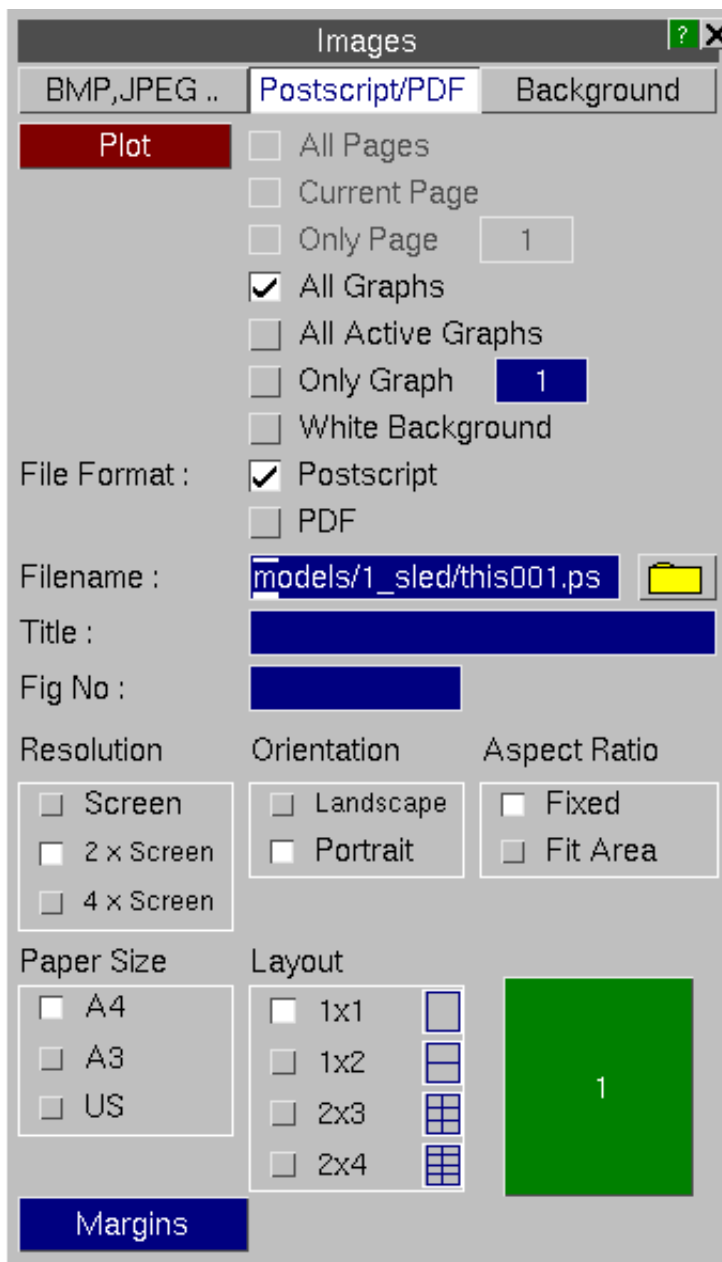
All images can be output at either the screen resolution or at a resolution of either 2 or 4 times the screen resolution.

- ☐ Screen
- ☐ 2 x Screen
- ☐ 4 x Screen

5.8.2 Postscript

This menu can be used to save an image containing one or more graphs to either a PDF or Postscript file.

All PDF and Postscript files are generated using raster images so that the contents of the screen is exactly reproduced.



All Pages

All T/HIS pages containing 1 or more graphs will be saved to a single file. *This option will only be available if T/HIS contains multiple graphs on more than one page (see Section 3.2).*

Current Page

The current T/HIS page will be saved.

This option will only be available if T/HIS contains multiple graphs on more than one page (see Section 3.2).

Only Page (n)

A single image containing the selected page will be generated.

This option will only be available if T/HIS contains multiple graphs on more than one page (see Section 3.2).

All Graphs

A single image will be generated containing all of the graphs.

This option will only be available if T/HIS only contains a single page (see Section 3.2).

All Active Graphs

A single image will be generated containing all of the currently active graphs.

This option will only be available if T/HIS only contains a single page ([see Section 3.2](#)).

Only Graph (n)

A single image containing the selected graph will be generated.

White Background

Captures the image with a white background and black foreground. Once the image is captured the colours are reset to their original values.

5.8.2.1 File Format

All images can be output at either the screen resolution or at a resolution of either 2 or 4 times the screen resolution.

☒ Postscript
☐ PDF
5.8.2.2 Title and Fig Number

By default PDF and Postscript files are not labeled and have no figure number, but you may add either or both of these. They are always put at the bottom of each page, along the short edge, regardless of the orientation used for plots.

Test output 1

1.1

5.8.2.3 Resolution

All images can be output at either the screen resolution or at a resolution of either 2 or 4 times the screen resolution.

☐ Screen
☐ 2 x Screen
☐ 4 x Screen
5.8.2.4 Orientation

All images can be output in either landscape or portrait format.

☐ Landscape
☐ Portrait
5.8.2.5 Aspect Ratio

By default all images are output using a fixed aspect ratio. This option can be used to stretch each image to fit the available space on the page. Different scaling factors will be applied to the horizontal and vertical directions and the image will be distorted.

☐ Fixed
☐ Fit Area
5.8.2.6 Paper Size

The paper size can be set to be either A4 (210 x 296mm), A3 (296 x 420mm) or US (letter - 216 x 279mm). The default size is A4.

☐ A4
☐ A3
☐ US
5.8.2.7 Layout

Multiple plots on a page are also available. In landscape format there is a choice of 1, 2x2, 3x3 and 4x4 plots to a page. In portrait format there is a choice of 1, 1x2, 2x3 and 2x4 plots on a page. By default there is a single plot on a page.

When multiple plots are requested the order in which they are performed can be defined.

☐ 1x1
 ☐

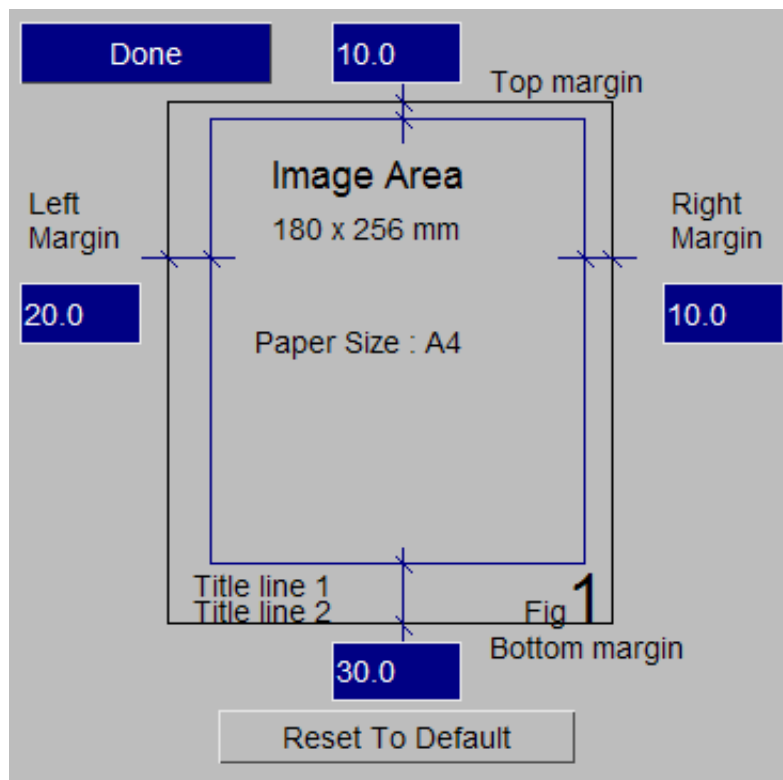
☐ 1x2
 ☐

☐ 2x3
 ☐

☐ 2x4
 ☐

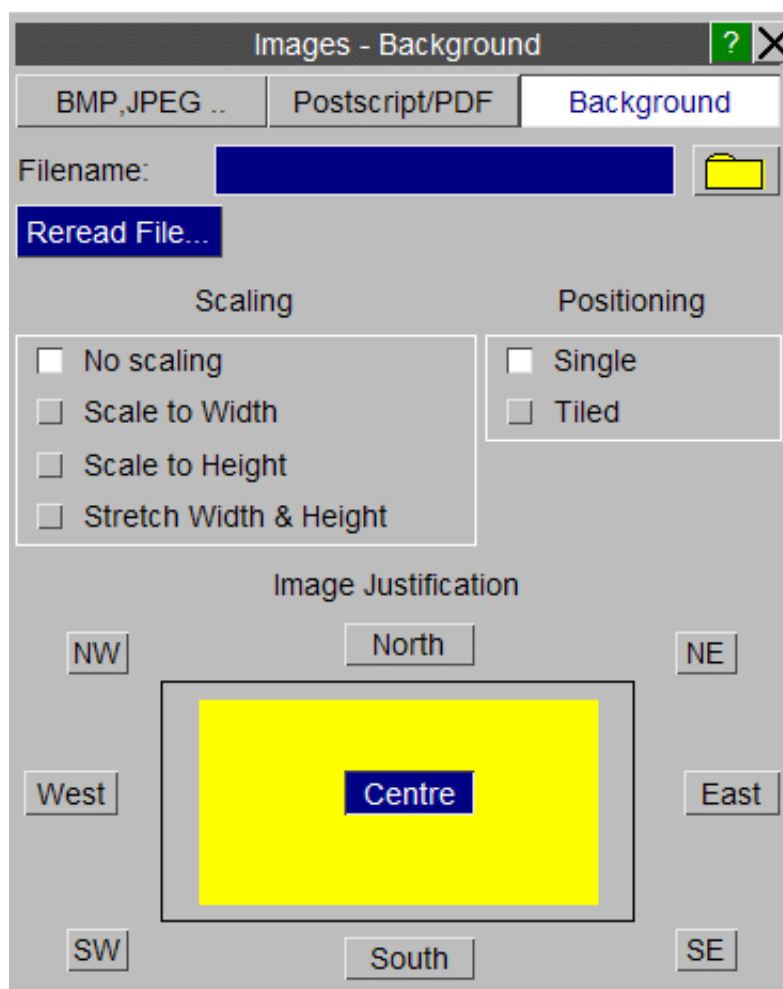
5.8.2.8 Margins

The Margins can be used to change the top, bottom, left and right margins for each page.



5.8.3 Background

This option can be used to add a background image to each graph (see section [5.16.7](#) for more details).



5.9 OPERATE Options

The **OPERATE** menu shown in the figure (right). If the mouse is left hovering over an option a short description of the function will appear.

For these functions, the user selects a range of curves to be operated on. A range may be one or more curves, making it possible to operate on multiple curves, for example add 20 curves to 20 curves.

Operate				
ABS	ADD (y)	ADD (x)	AVE	CAT
CLIP	Add to Y	DIF	DIV (y)	DIV (x)
ENV	ERR	INT	LSQ	MAP
MAX	MIN	MON	MUL (y)	MUL (x)
NOR (y)	NOR (x)	ORDER	REC	REV
R-AVE	SMO	SQR	STRESS	SUB (y)
SUX (x)	SUM	TRA	VEC	VEC(2D)
WINDOW	ZERO			

The options with the **OPERATE** menu are split into 3 groups. The first group require 2 sets of curves as input. The second group require a single set of curves as input. The third group also require a single set of curves as input but the output from these functions is a single curve. (See [Section 5.0](#) for more information on curve groups).

5.9.1 ABS

Produces the absolute y-values of a curve.

5.9.2 ADD

Add the y axis values together for two curves or add a constant value to all the y-values. If two curves are being added together they must have identical x-axis values.

5.9.3 ADX

Add the x axis values together for two curves or add a constant value to all the x-values. If two curves are being added together they must have identical y-axis values.

5.9.4 AVE

Produces a single curve that is the average of the input curves.

5.9.5 CAT

Concatenate the second curve to the end of the first.

5.9.6 CLIP

Clip a curve to remove any points that exceed a set of specified minimum and maximum x & y axis value. The user is prompted for minimum and maximum values after the curves have been selected..

X minimum value	-0.10000E+21
X maximum value	0.10000E+21
Y minimum value	-0.10000E+21
Y maximum value	0.10000E+21

5.9.7 COM

Two curves are combined to give a new curve. For example if a displacement/time curve is combined with a velocity/time curve a velocity/displacement curve will result.

If the 2 curves do not contain points at the same x values then the curve with the larger x-axis intervals is automatically mapped on to the x-axis values of the other curve.

If the curves do not start and finish at the same x-axis values then only the points for which the two curve x-axes overlap are mapped onto each other.

5.9.8 DIF

A curve is differentiated with respect to the x-axis variable.

5.9.9 DIV

Divide the y axis values of the first curve by the y axis values of the second curve (or a constant). If two curves are being used they must have identical x-axis values.

5.9.10 DIX

Divide the x axis values of the first curve by the x axis values of the second curve (or a constant). If two curves are being used they must have identical y-axis values.

-
- 5.9.11 ENV** Produces a single curve that bounds the maximum and minimum values of the group of input curves.
- 5.9.12 ERR** This option reports the degree of correlation between 2 input curves. The first curve selected is used as a reference curve and the following parameters are then reported :
- | | |
|--|--|
| Maximum difference : | Value & Time
Value as a %age of reference curve
Value as a %age of reference curve peak value. |
| Average difference - | Value
%age of reference curve peak value |
| Area Weighted Difference Correlation Parameter - | 0 to 1 |
- For more details on this function please see [Appendix G](#)
- 5.9.13 INT** A curve is numerically integrated with respect to the x-axis variable using Simpson's rule.
- 5.9.14 LSQ** Fits a straight line through the points using the least squares method.
- 5.9.15 MAP** The second curve is mapped onto the first curve, the resulting curve has identical x-axis values to the reference (first) curve with y-axis values obtained from the mapped (second) curve.
- 5.9.16 MAX** Produces a single curve that bounds the maximum values of the group of input curves.
- 5.9.17 MIN** Produces a single curve that bounds the minimum values of the group of input curves.
- 5.9.18 MON** Sorts a curve into monotonically increasing x-axis values.
- 5.9.19 MUL** Multiply the y axis values together for two curves or multiply all the y-values by a constant. If two curves are being multiplied together they must have identical x-axis values.
- 5.9.20 MUX** Multiply the x axis values together for two curves or multiply all the x-values by a constant. If two curves are being multiplied together they must have identical y-axis values.
- 5.9.21 NOR** Normalize a curve so that the y axis values lie in the range [-1, +1].
- 5.9.22 NOX** Normalize a curve so that the x axis values lie in the range [-1, +1].
- 5.9.23 ORDER** Reverse the order of all the points in the curve.
- 5.9.24 REC** Produces the reciprocal of the y-values of a curve.
- 5.9.25 REV** Reverses the x and y axes of a curve. For example if you start with a curve with displacement (y axis) against time (x axis) you end up with a curve of time (y axis) against displacement (x axis).
- 5.9.26 R-AVE** Produces a single curve of the running average on the input curve.
-

5.9.27 SMO

A moving average technique is used to smooth (filter) a curve. The user will be prompted for a smoothing factor.

Smoothing Factor > 1 (integer)

7

The integer refers to the number of points included in the averaging of each point. The value you want will depend on the number of points in the curve and the amount of smoothing required. A certain amount of trial and error is necessary to get the required result.

5.9.28 SQR

Take the square root of the y-values of a curve.

5.9.29 STRESS

Converts a stress / strain curve between True and Engineering Stress /Strain.

5.9.30 SUB

Subtract the y axis value (or constant) of the second curve from the first curve. If two curves are being subtracted they must have identical x-axis values.

5.9.31 SUX

Subtract the x axis value (or constant) of the second curve from the first curve. If two curves are being subtracted they must have identical y-axis values.

5.9.32 SUM

Calculates the sum of a group of curves. This "sums" up the y-axis values of a group of curves, and maps the result onto the x-axis of the first curve.

5.9.33 TRA

Translate a curve with respect to the x and y axes. The user is prompted for the x and y values.

X Translation

0.0000

Y Translation

0.0000

5.9.34 VEC

Calculate the vector magnitude from three input curves.

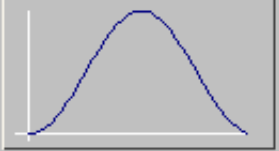
5.9.35 VEC(2-D)

Calculate the vector magnitude from two input curves.

5.9.36 WINDOW

This function is typically used to modify a curve before carrying out an FFT on it.

The y-axis values for each of the input curves is multiplied by a factor between 0 and 1. Three different window shapes are available. The **Store Window Curve** option can be used to output the multiplying factors to a separate curve if required.

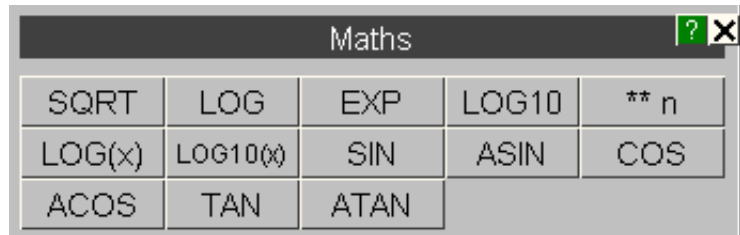
☐ Hanning	
☐ Cosine Taper	
☐ Exponential	
☐ Store Window Curve	
10.000	%age Lead-in

5.9.37 ZERO

Translate a curve so that the first data point is moved to (0,0).

5.10 MATHS Options

The **MATHS** menu is shown in the figure (right). This menu allows mathematical operations to be applied to curves. These options are self explanatory and work on the y-value of the curve (except where explicitly stated).



Note: Trigonometrical functions expect the user to work in radians.

- | | |
|------------------------|--------------------------------|
| 5.10.1 SQRT | The square root of a curve. |
| 5.10.2 LOG | Natural log (to base e) |
| 5.10.3 EXP | e to power of. |
| 5.10.4 LOG10 | Log to base 10 |
| 5.10.5 **n | Raise to power n. |
| 5.10.6 LOG(x) | Log to base 10 (x-axis values) |
| 5.10.7 LOG10(x) | Log to base 10 (x-axis values) |
| 5.10.8 SIN | Sine (radians assumed) |
| 5.10.9 ASIN | Arc sine |
| 5.10.10 COS | Cosine |
| 5.10.11 ACOS | Arc cosine |
| 5.10.12 TAN | Tangent |
| 5.10.13 ATAN | Arc tangent |

5.11 AUTOMOTIVE Options

The **AUTOMOTIVE** menu is shown in the figure (right). The automotive options are a number of operations that can be performed on curves, typically finding their use in the Automotive industry. They consist of filters and injury criteria calculations, along with a number of other useful functions.

Automotive				
C60	C180	C600	C1000	BUT
BUT(p)	FIR	HIC	HIC(d)	3ms CLIP
EXC	VC	ASI	THIV	NIJ
TTI	NOR (y)	NOR (x)	REG	VEC
VEC(2d)	ACU	COR1	COR2	COR3

All the options in the **AUTOMOTIVE** menu require a single set of curves as input except the **VEC** and **VEC(2D)** options which require groups of 3 or 2 curves respectively as input but only output a single curve. (See [Section 5.0](#) for more information on curve groups).

Notes on using the various filters

When filtering curves the sampling rate of the data should be considered: it should be at least twenty times the filter cutoff frequency if good results are to be obtained.

T/HIS will reject attempts to filter curves for which the sampling rate is too low, if this happens the **REG** option can be used to increase the number of points. This will allow the filter to function although it is not a good substitute for obtaining data at a higher sampling rate.

For more information on the filters and injury criteria calculations see [Appendices D & G](#).

All of the filters expect the input curve to have a consistent time interval. When using one of the filter options the user can specify a time interval for the curve to be automatically regularised to (**REG**) before filtering if the time interval is not consistent. The user can set a default time interval for regularising the input curves in the PREFERENCE menu. The PREFERENCE menu can also be used to automatically convert the x axis values from milliseconds to seconds before filtering and to convert the curve back to milliseconds afterwards.

5.11.1 C60 Filter a curve using a standard SAE Class 60 filter.

5.11.2 C180 Filter a curve using a standard SAE Class 180 filter.

5.11.3 C600 Filter a curve using a standard SAE Class 600 filter.

5.11.4 C1000 Filter a curve using a standard SAE Class 1000 filter.

5.11.5 BUT The curve is passed through a Butterworth filter. The user is prompted for the cutoff frequency and the order of the filter.

Cut-off frequency (Hz)	1000.0
Filter order (integer)	1

5.11.6 BUT(p) This passes a curve through a Pure Butterworth filter. This is the same as the BUT function above, but the two refinements, described in [Appendix D](#), to minimise end-effects and phase change errors are not included.

5.11.7 FIR Special filter for US "SID" dummy.

5.11.8 HIC

Calculates the Head Impact Criteria from an acceleration time history. The user is prompted for the time window and the acceleration conversion factor.

Normally this option writes the HIC value to the screen. If required the values may also be written out to a file using the **WRITE TO FILE** option.

The time unit for the input curve should be seconds. T/HIS look at the range of the x-axis values and if the range is >1 then T/HIS will assume the x-axis values are in ms and it will automatically divide the x-axis values by 1000.

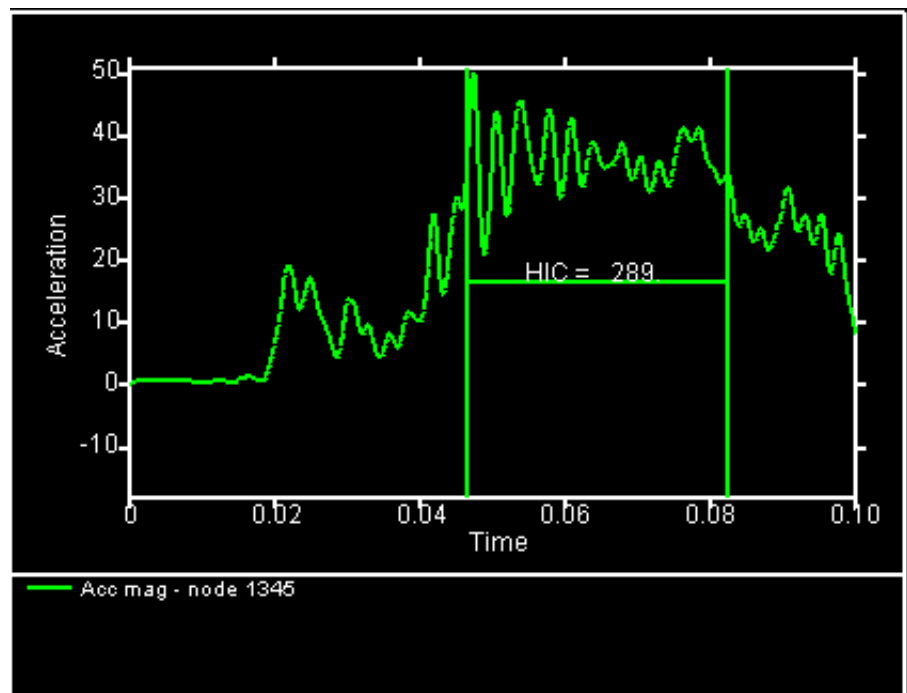
If the y-axis values are not in (G) then an optional factor can be specified that T/HIS will DIVIDE the y-axis values by to convert them to (G).

Example factors for different units are :

Unit	Factor
m/s ²	9.81
mm/s ²	9810
mm/ms ²	0.00981

In addition to calculating and reporting the HIC value the time window and value can be displayed on the graph using the **Show HIC Value** option.

See [Appendix E](#) for more details on the Head Impact Criteria calculation.



5.11.9 HIC(d)

HIC(d) is used to calculate the Head Injury Criteria for the Free Motion Headform used within the FMVSS201 legislation. The equivalent dummy HID(d) is calculated as follows

$$\text{HIC(d)} = 0.75446 \times (\text{free motion headform HIC}) + 166$$

5.11.10 CLI

Calculates the **3ms clip** value from an acceleration time history. Normally this option writes the value to the screen, and produces a curve of the clip region.

By default the screen value will be labeled as "**3ms = value**". This label can be modified by specifying a different **Screen Label**.

If required the values may also be written out to a file using the **WRITE TO FILE** option. In addition to calculating and reporting the 3ms clip value the time window and value can be displayed on the graph using the **Show 3ms Clip Value** option.

See [Appendix E](#) for more details on the 3ms clip calculation.

5.11.11 EXC

Calculate and displays an **EXC**eedence plot. This is a plot of force (y-axis) versus cumulative time (x-axis) for which the force level has been exceeded. By default the **Automatic** option will create an exceedence plot using either the +ve OR the -ve values depending on which the input curve contains most of. The **Positive** option will calculate the exceedence plot using only the points with +ve y values. The **Negative** option will calculate the exceedence plot using only the points with -ve y values.

5.11.12 VC

Calculates the **Viscous Criteria** from an acceleration time history. The user is prompted for the constants A and B. See [Appendix E](#) for more details on the VC calculation.

5.11.13 ASI

Acceleration Severity Index. This value is used to assess the performance of road side crash barriers.

This option requires 3 acceleration input curves. The user is prompted for the acceleration limits in the 3 directions. See [Appendix E](#) for more details on this calculations.

5.11.14 THIV

Theoretical Head Impact Velocity and the Post Impact Head Deceleration. These values are used to assess the performance of road side crash barriers.

This option requires 3 input curves, a longitudinal and lateral acceleration and a rotation rate. The user is prompted for the constants Dx, Dy and X0. See [Appendix E](#) for more details on these calculations.

5.11.15 NIJ

Biomechanical neck injury predictor. Used as a measure of injury due to the load transferred through the occipital condyles.

This option requires 3 input curves. 1 to represent Shear force, 1 to represent Axial force and a third to represent bending moment in the dummy's upper neck loadcell. Enter these curves in the corresponding input boxes.

The 4 critical constants used to calculate NIJ; Fzc (tension), Fzc (comp), Myc (flexion) and Myc (extension) default to the values specified by the test creators. These can be changed by entering different values into the respective boxes.

Enter the e distance into the e (distance) box.

Select which curves you wish to output to in the Output box.

For more information on the calculation of NIJ, refer to [Appendix E](#)

NIJ will output 4 curves due to the 4 possible loading conditions for Nij;



Nte is the tension-extension condition

Ntf is the tension-flexion condition

Nce is the compression-extension condition

Ncf is the compression-flexion condition

5.11.16 TTI

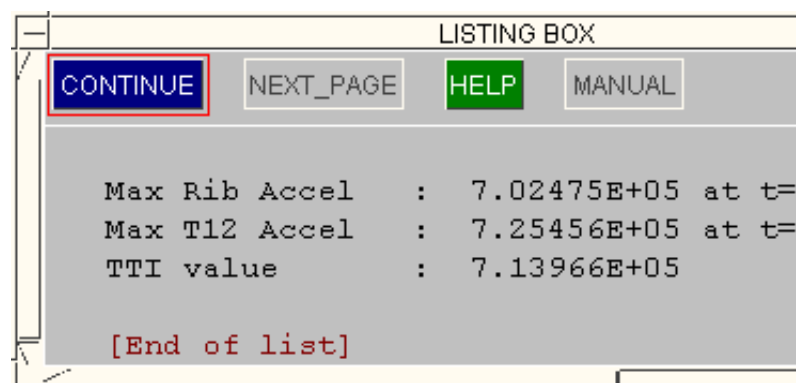
Thorax Trauma Index:

This option requires 3 input curves. 1 to represent the Upper Rib Acceleration, 1 to represent the Lower Rib Acceleration and a third to represent the Lower Spine Acceleration. Enter these curves in the corresponding input boxes.

The output can either be written to the screen, appearing in a listing box, or written to a file specified in the File: input box, or both.

If the write to screen tab is highlighted, the following window will appear:

For more information on the calculation of TTI, refer to [Appendix E](#)



- 5.11.17 NOR(y)** Normalise the curve so that the Y values are within the range [-1, +1].
- 5.11.18 NOR(x)** Normalise the curve so that the X values are within the range [-1, +1].
- 5.11.19 REG** Make a curve have a constant time step.

It is necessary for a curve to have a constant time step between points for it to be filtered. This option takes an existing curve and prompts the user for a new time step. The points of the output curve are calculated by linear interpolation. Regularising a curve may alter its peak values, and could change filtered output slightly.
- 5.11.20 VEC** Calculate the vector magnitude of three input curves.
- 5.11.21 VEC2D** Calculate the vector magnitude of two input curves.
- 5.11.22 ACU** Airbag control Unit
- 5.11.23 COR1** Curve correlation function.

The Correlation function provides a measure of the degree to which two curves match. When comparing curves by eye, the quality of correlation may be judged on the basis of how well matched are the patterns of peaks, the overall shapes of the curves, etc, and can allow for differences of timing as well as magnitude. Thus a simple function based on the difference of Y-values (such as T/HIS ERR function) does not measure correlation in the same way as the human eye. The T/HIS correlation function attempts to include and quantify the more subtle ways in which the correlation of two curves may be judged.

The input parameters for the COR1 function have been chosen so as to produce a strict judgement of the correlation (see Appendix F for more details).
- 5.11.24 COR2** The COR2 function is the same as COR1 except the input parameters have been chosen so as to produce a less strict judgement of the correlation (see Appendix F for more details).
- 5.11.25 COR3** Another curve correlation function.

This function first normalises the curves using two factors either specified by the user or defaults calculated by the program (the maximum absolute X and Y values of both graphs). For each point on the first normalised curve, the shortest distance to the second normalised curve is calculated. The root mean square value of all these distances is subtracted from 1 and then multiplied by 100 to get an index between 0 and 100. The process is repeated along the second curve and the two indices are averaged to get a final index. The higher the index the closer the correlation between the two curves.

Note that the choice of normalising factors is important. Incorrect factors may lead to a correlation index outside the range of 0 to 100 (see Appendix F for more details).

5.12 SEISMIC Options

The **SEISMIC** menu is shown in the figure (right). T/HIS can be used to handle response spectra information. In particular, displacement, velocity or acceleration spectra can be read and converted to another format.



- 5.12.1 DV** Displacement spectrum is converted to a velocity spectrum
- 5.12.2 DA** Displacement spectrum is converted to an acceleration spectrum
- 5.12.3 VD** Velocity spectrum is converted to a displacement spectrum
- 5.12.4 VA** Velocity spectrum is converted to an acceleration spectrum
- 5.12.5 AD** Acceleration spectrum is converted to a displacement spectrum
- 5.12.6 AV** Acceleration spectrum is converted to a velocity spectrum.
- 5.12.7 DS** Produce a design spectrum from a response spectrum through the specification of a broadening factor..
- 5.12.8 RS** Produce a response spectrum from input accelerations. This gives the response of a damped single degree of freedom system, given its damping factor and period, to the input acceleration time-history.
- 5.12.9 FFT** Perform a fast Fourier transform. Convert an input signal from the time to the frequency domain.
- There are three options for output;
- magnitude only
 - magnitude and phase
 - real and imaginary components of the time signal.
- The frequency is calculated in Hz NOT radians/s if the time axis is in seconds.
- T/HIS automatically adds points with zero y-value to the end of the curve to pad the curve out so that the number of points to the next power of 2.
- An option to regularise the curve before performing the function is on by default. The spacing between points on the frequency axis of the resulting curve is determined by the time duration of the padded input curve; $dx = 1.0/(\text{time})$.
- The highest frequency in the output curve is determined by the time interval of the input curve; $F(\text{max}). = (\#points)/dt$
- 5.12.10 IFFT** Performs an inverse fast Fourier transform. Converts two input signals from the frequency to the time domain. The two input signals can be the magnitude and phase or real and imaginary components of the time signal.
- 5.12.11 NCP** By default beam element plastic rotations are always written out by LS-DYNA as being increasing +ve (i.e. cumulative). This option allows a non-cumulative plastic rotation to be calculated by taking two input curves: the moment/time and the cumulative rotation/time histories for the beam in question.
- 5.12.12 BLC** Baseline correction.

5.13 MACRO Options

The **MACRO** menu can be used to play FAST-TCF based macro files on existing T/HIS curves.

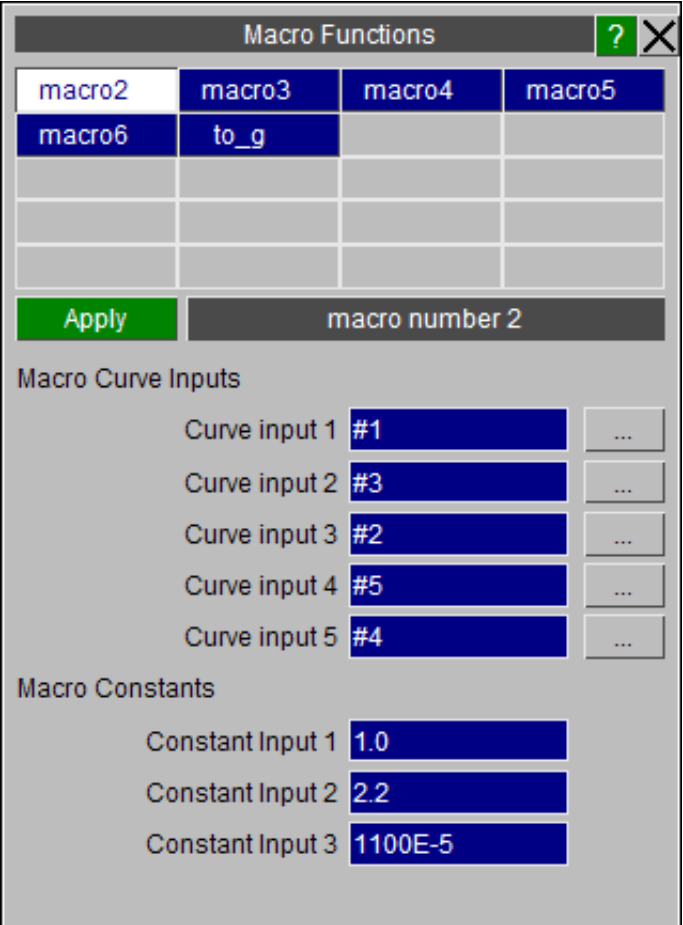
T/HIS macro files can be stored in any directory. Each user can define up to three macro areas using the oa_pref option:

this*macro_directory:
C:\blah\macros

T/HIS will read any **.thm** files within the macro directories and generate the macro menu (shown right) using keywords within the macro scripts. T/HIS will search the macro directories in the following order.

this*macro_directory from SYSTEM oa_pref file
this*macro_directory from users oa_pref file
this*macro_directory from local oa_pref file

The scripting for a macro in T/HIS is based upon FAST-TCF using variables within the script (see [FAST-TCF section](#) for more details). There are some extra command options to make T/HIS aware of input curves and constants within the macro. These macro keywords are as follows:



macro acr <name>	acronym for the macro button in T/HIS
macro title <description>	a more descriptive title for the macro
macro curve <curve variable> <curve description>	FAST-TCF variable name for input curve followed by curve description
macro const <const variable> <curve description>	FAST-TCF variable name for input constant followed by constant description

If one or more macro files are found with duplicate acronyms then only the last file read will be displayed so users can override SYSTEM macros with there own definitions if they want to.

When the user selects one of the Macro functions the macro file associated with the function is read and T/HIS creates a selection menu for the user to define the relevant curve numbers and constant values to input into the macro script. These inputs will **replace** the variables used within the macro.

For example: If the user selects **#1** for the macro curve variable **macro_input**, then any occurrence of **\$macro_input** in the macro script will be replaced by **#1**.

An example macro script follows. This macro asks the user for a filter option (e.g. c60, c600, c1000) and also an input curve number. The macro then filters the input curve and divides by 9810.

```
# Macro to convert a file to g after filtering
#
macro acr to_g
macro title filter and convert curve to g
macro curve macro_input input curve
macro const macro_filter filter to use
#
model none
model 1
oper $macro_filter $macro_input tag filtered
oper div filtered 9810.0
```

5.14 FAST-TCF Options

The **FAST-TCF** menu can be used to capture and playback FAST-TCF scripts. FAST-TCF is a simple and intuitive scripting language for T/HIS. See [FAST-TCF \(section 7\)](#) for more details and commands.

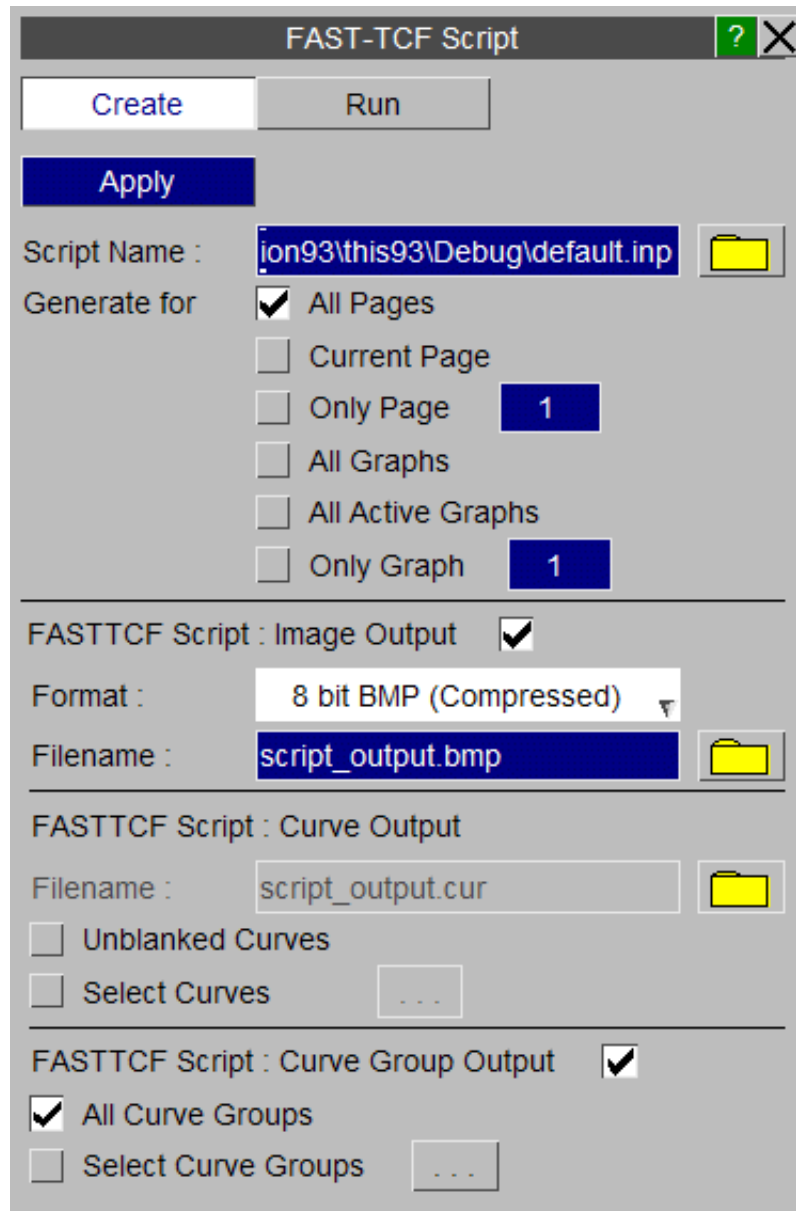
5.14.1 Create

T/HIS 9.2 onwards has the ability to automatically generate FAST-TCF scripts using the CREATE menu.

The FAST-TCF script will contain all of the commands required to

1. Create and position multiple graphs on pages.
2. Extract the data from models or other files
3. Carry out any curve operations required to reproduce the chosen curves
4. Set any curve styles and labels
5. Set plot attributes such as titles, axis labels, colours, fonts and scaling
6. Generate the output image and/or curve file
7. Generate curve groups

Before generating the FAST-TCF script the following options can be set



FAST-TCF Script [?] [X]

Create **Run**

Apply

Script Name : [Folder Icon]

Generate for

- ☒ All Pages
- ☐ Current Page
- ☐ Only Page
- ☐ All Graphs
- ☐ All Active Graphs
- ☐ Only Graph

FASTTCF Script : Image Output ☒

Format : [Dropdown Arrow]

Filename : [Folder Icon]

FASTTCF Script : Curve Output

Filename : [Folder Icon]

- ☐ Unblanked Curves
- ☐ Select Curves

FASTTCF Script : Curve Group Output ☒

- ☒ All Curve Groups
- ☐ Select Curve Groups

Generate For

All Pages

The FAST-TCF script will contain all of the commands required to regenerate all of the pages that contain 1 or more graphs.

If the option to generate images is selected then the FAST-TCF script will contain the commands to generate multiple images with the page number appended to the filename specified.

Current Page

The FAST-TCF script will contain all of the commands required to regenerate the currently displayed page.

Only Page (n)

The FAST-TCF script will contain all of the commands required to regenerate the selected page.

All Graphs

The FAST-TCF script will contain all of the commands required to regenerate all the currently defined graphs.

All of the graphs will be positioned on page 1 using the currently defined layout.

This option will only be available if T/HIS only contains a single page ([see Section 3.2](#)).

All Active Graphs

The FAST-TCF script will contain all of the commands required to regenerate all of the active graphs.

All of the graphs will be positioned on page 1 using the currently defined layout.

This option will only be available if T/HIS only contains a single page ([see Section 3.2](#)).

Only Graph (n)

The FAST-TCF script will contain all of the commands required to regenerate the selected graph.

The graph will be positioned on page 1.

FAST-TCF Script : Image Output

If this option is selected then the FAST-TCF script will contain the commands required to generate an image of each of the pages/graphs selected for output. The **Image Format** can be set to any of the supported image types ([see Section 5.8](#)).

If the FAST-TCF script generates multiple pages then the **Filename** specified will be used for the first image. Subsequent images will use the specified filename with "_2", "_3" ... appended.

FAST-TCF Script : Curve Output

By default the FAST-TCF script will only contain the command needed to reproduce the curves that are unblanked in 1 or more of the graphs selected for output. This option can be used to select additional curves for which the commands required to generate them are also added to the FAST-TCF script. If a curve is selected that is also unblanked in one of the graphs the command to regenerate it are only added to the FAST-TCF script once.

In addition to selecting additional curves this option can also be used to add commands to the FAST-TCF script to write the additional curves out to a T/HIS .cur curve file.

FAST-TCF Script : Curve Group Output

This option can be used to select additional curves for output to the FAST-TCF script by curve group. If a curve is selected that is also unblanked in one of the graphs the command to regenerate it are only added to the FAST-TCF script once. This option will also add the commands to regenerate the selected curve groups to the FAST-TCF script.

5.14.2 Run

This menu allows the user to run a FAST-TCF file from within T/HIS. After the user has selected the FAST-TCF file T/HIS scans the file for data requests and model requests to see what input the FAST-TCF file requires. Note that there must be a model read into T/HIS before a FAST-TCF file that contains data extraction can be run.

The next FAST-TCF command line is displayed in red in the upper text area, at this point the user can select to **Play** the FAST-TCF file or **Step** through it line by line. After every line of FAST-TCF the resulting command in T/HIS is shown in the lower text area. Select **End** during stepping through the lines to go to the end of the file. **Reread** will re read the file and start back at the beginning.

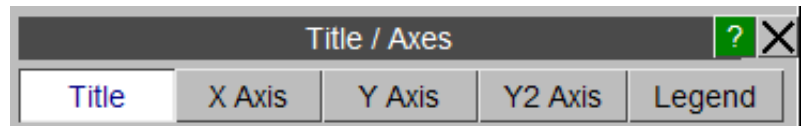
The **Model Mapping** option allows the user to define which model in T/HIS should be used for the equivalent model number in the FAST-TCF script. The model number **zero** is equivalent to the default model in FAST-TCF if no models are defined. The default model mapping will use the same model numbers as in the FAST-TCF script.

Auto confirm text boxes will force T/HIS to confirm any text boxes that should appear in the interactive playback of a FAST-TCF script (such as HIC results and so on).

The FAST-TCF script will ignore any existing T/HIS curves and their tags. This guarantees that the user can run a single FAST-TCF file many times and it will only use the new curves created by FAST-TCF.



5.15 TITLE/AXES/LEGEND Options



The **TITLE/AXES** menu is shown in the figure (right).

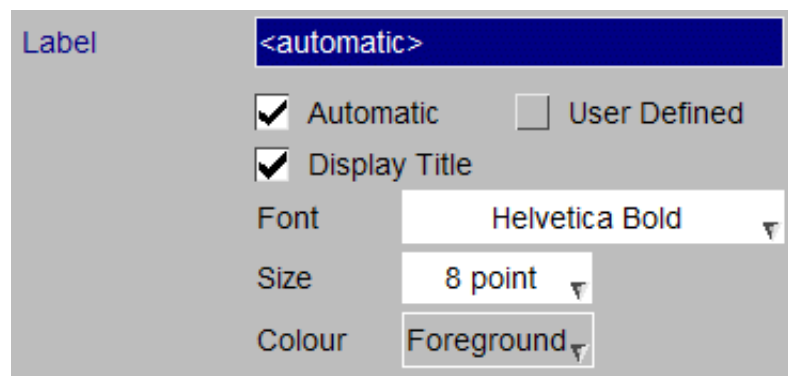
This menu controls the contents of the title and axes labels and the axis scaling.

The individual axis, title and legend menus can also be accessed by clicking over the appropriately highlighted area on the graph.

Changes to the TITLE/AXES/LEGEND options are only applied to active graphs ([see Section 3.5](#)).

5.15.1 TITLE

The plot title may be set **AUTO**matically or manually. When the **AUTO** option is selected the text box will display **<automatic>** and the plot title will be set to the title of the first curve that is currently being plotted. The plot title may be turned on and off by toggling the **ON/OFF** button.



5.15.2 X-AXIS

AXIS LABELS

The x-axis label may be set automatically or a user defined label can be specified.. When the **AUTOMATIC** option is selected the text box will display **<X automatic>** and the axis label will be set to the x axis label of the first curve that is currently being plotted. The axis label may be turned on and off by toggling the **Display Label** button.

In addition to displaying the axis labels an optional unit label can also be appended to the axis label. If the option to add a unit label is set to Automatic then the unit label displayed will depend on the current curves that are visible and the current unit system being used to display results (see [Section 5.22](#) for more information on Unit Systems). If the curves being displayed do not have the same axis unit then no unit label will be displayed. The unit label may be turned on and off by toggling the **Add Units** button.

AXIS LIMITS

The minimum and maximum x axis values can be controlled using a combination of the text box and the popup menu opposite.

Autoscale

The axis values will be set to the maximum and minimum values of all the curves that are currently being plotted.

Locked

The axis limit is set to the user defined value specified in the text box. If the curves are translated or scaled dynamically the limit will be reset.

Note : The global command **AUTOSCALE** (see [Section 4.5](#)) will reset the minimum and maximum values to **AUTO**.

AXIS TYPE

The x-axis can be switched between a **Linear** or **Logarithmic** scale. If a **Logarithmic** scale is selected a warning will be generated if an attempt is made to plot points that have -ve or zero X values and the points will be skipped.

GRID SPACING

By default T/HIS will automatically set the grid line intervals for the x-axis when the grid is turned on (see [Section 5.16.5](#)). If the GRID option is changed from **Automatic** to **Manual** a grid **Interval** and **Offset** may be specified. If the **Interval** is set to 0.1 and the **Offset** to 0.02 then grid lines will be produced at 0.02, 0.12, 0.22

UNITS

Axis values can be displayed using 3 different formats

Automatic

Values are displayed using exponential format, all values are displayed as values of E0, E3, E6 etc.

e.g 11.234E+03

Scientific

Values are displayed using exponential format.

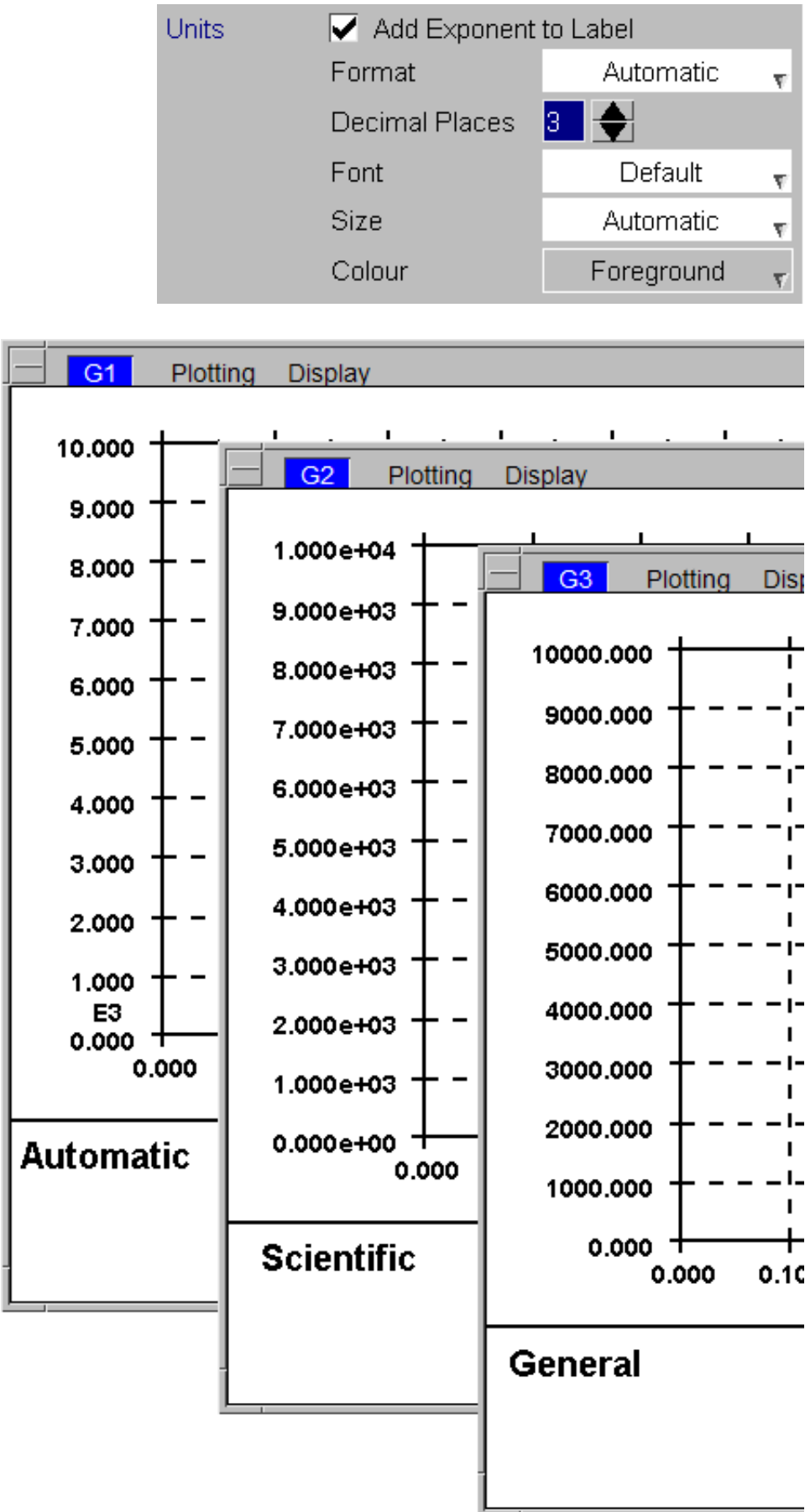
e.g 1.123E+04

General

Values are displayed as real numbers.

e.g 11234.000

In addition to specifying the format, the number of decimal places can also be set between 0 and 9 and the colour and font used to display the values can be set.



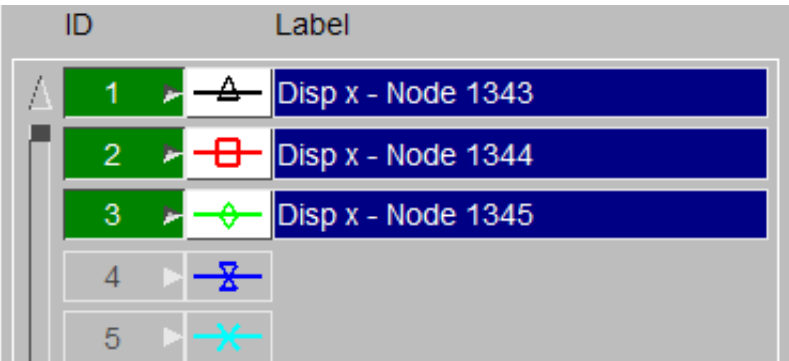
5.15.3 Y-AXIS

The same options for LABELS, LIMITS, SCALE, GRID LINES and UNITS apply to the Y-AXIS as those available for the X_AXIS.

5.15.4 Second Y-AXIS

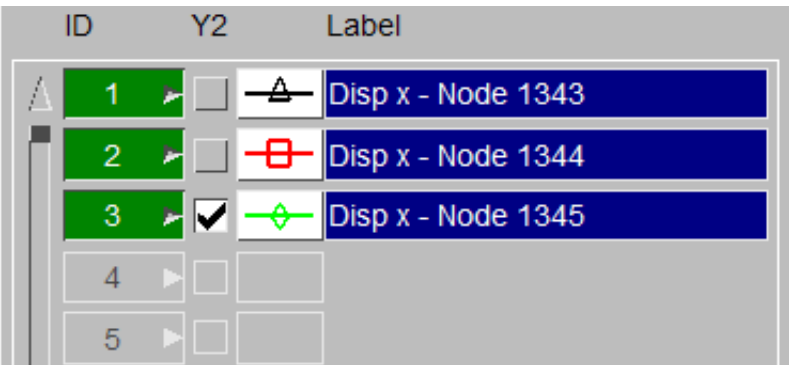
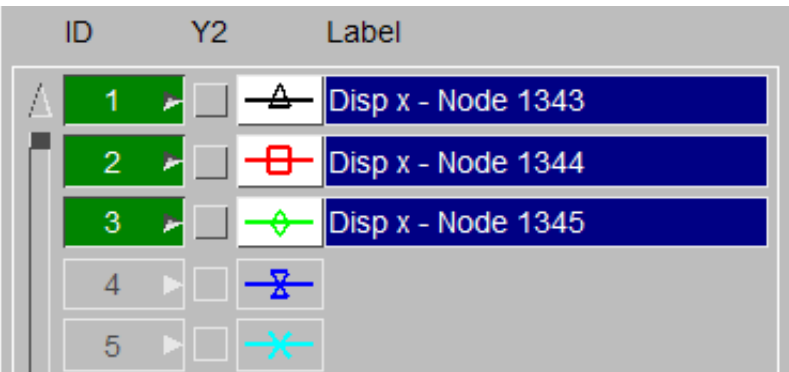
Curves can be plotted in T/HIS using 2 different y-axis scales. When **DOUBLE Y-AXIS** is selected using the check box in the Y2 Axis menu the curve management window changes

from



to

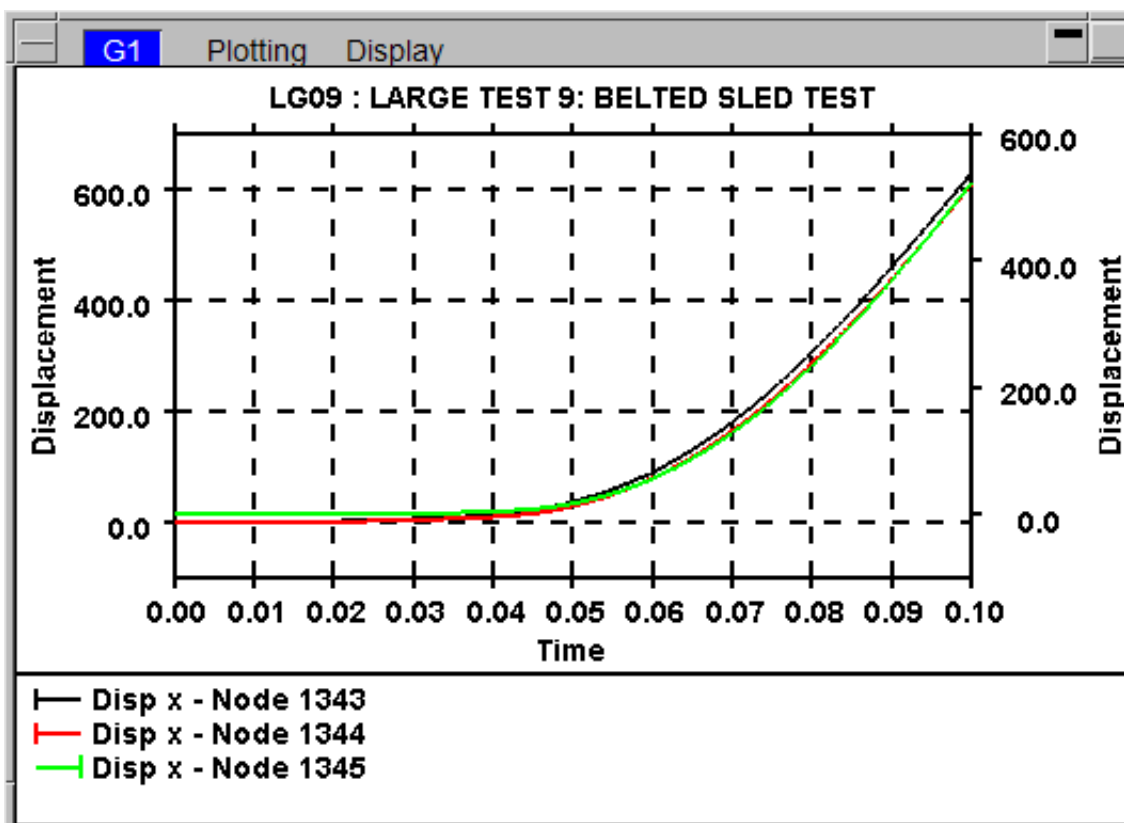
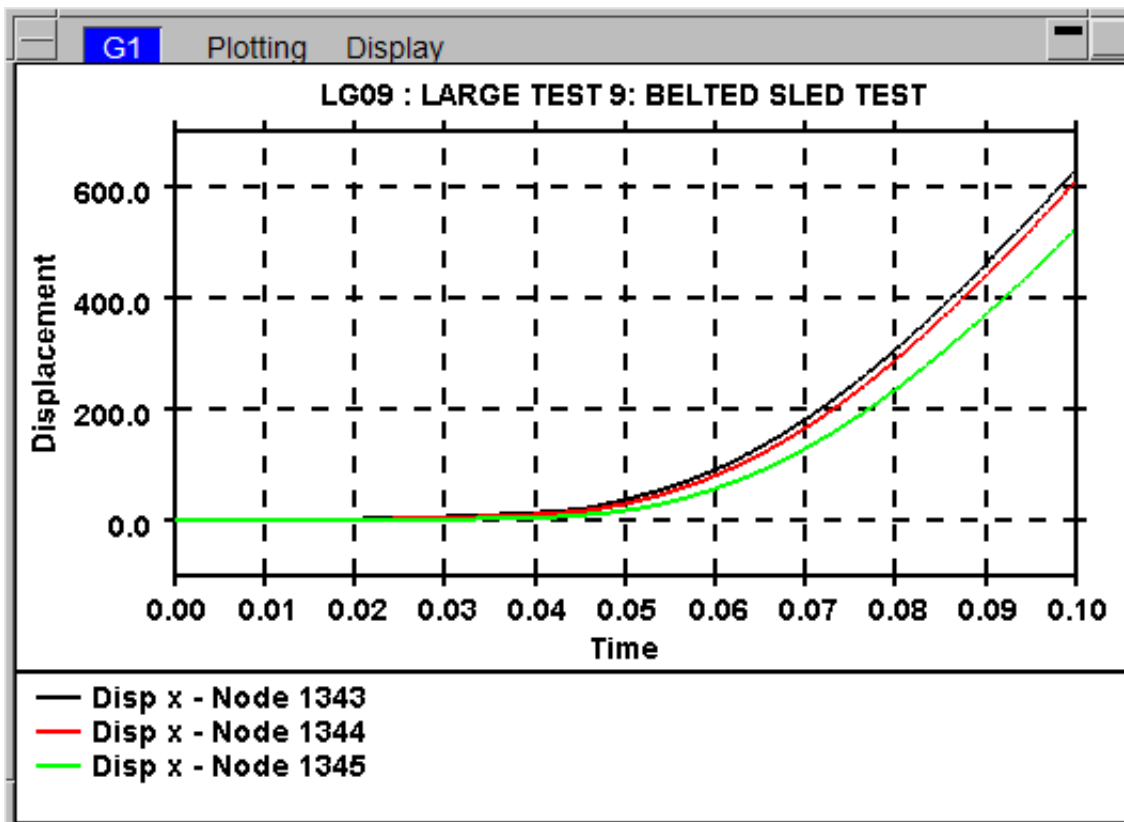
with an additional tick box for each curve that controls which curves are plotted against the second (right hand) y-axis.



If only one y-axis scale is used it is not possible to meaningfully plot curves with different units or very different values. A second scale allows more information to be displayed at once, as demonstrated below.

To identify which axis a curve is being plotted against the line labels on the plot are automatically modified.

Second Y axis disabled	— Disp x - Node 1343
Left hand Y axis	└─ Disp x - Node 1343
Right hand y axis	─┤ Disp x - Node 1343



All of the options that are available to control the label, scale and type of the y-axis are also available for the second y-axis except for the Grid option.

NOTE : When the DOUBLE AXIS option is used with GRID lines a grid is only plotted for the left hand y-axis.

5.15.5 Legend

5.15.5.1 Curve Labels

Show Prefix

This option can be used to automatically add a prefix to each of the curve legends when a curve is plotted. This option has 3 settings

Automatic

If there is more than 1 model loaded in T/HIS then a prefix will automatically be added to any curves that have been read in from a model. Curves read in from other files will not be prefixed.

On

A prefix will automatically be added to any curves that have been read in from a model regardless of the number of models currently loaded in T/HIS. Curves read in from other files will not be prefixed.

Off

No prefixes will be added

Prefix Format

This option can be used to set the format used for the curve prefix. This option has 4 settings

Model Number	The model number will be used as the prefix. e.g. (M1)
Directory	The directory name the model was read from will be used as the prefix. e.g. (/run1)
THF File	The root name of the THF file will be used as the prefix. e.g. (sled_test)
User Defined	A user defined prefix will be used. The prefix can be defined on a model by model case using the Model Menu .

The font, size and colour of the text used to display the legends can also be specified.

Title / Axes [?] [X]

Title | **X Axis** | **Y Axis** | **Y2 Axis** | **Legend**

Curve Labels

Show Prefix: Automatic

Prefix Format: Model Number

Font: Default

Size: Automatic

Colour: Foreground

Layout

☒ Default

☐ Auto

☐ Full

☐ Floating

☐ 1 Column

☒ 2 Columns

☐ 3 Columns

User Lines

☒ Display Lines

Size: Automatic

Reset

Font: Default

Colour: Foreground

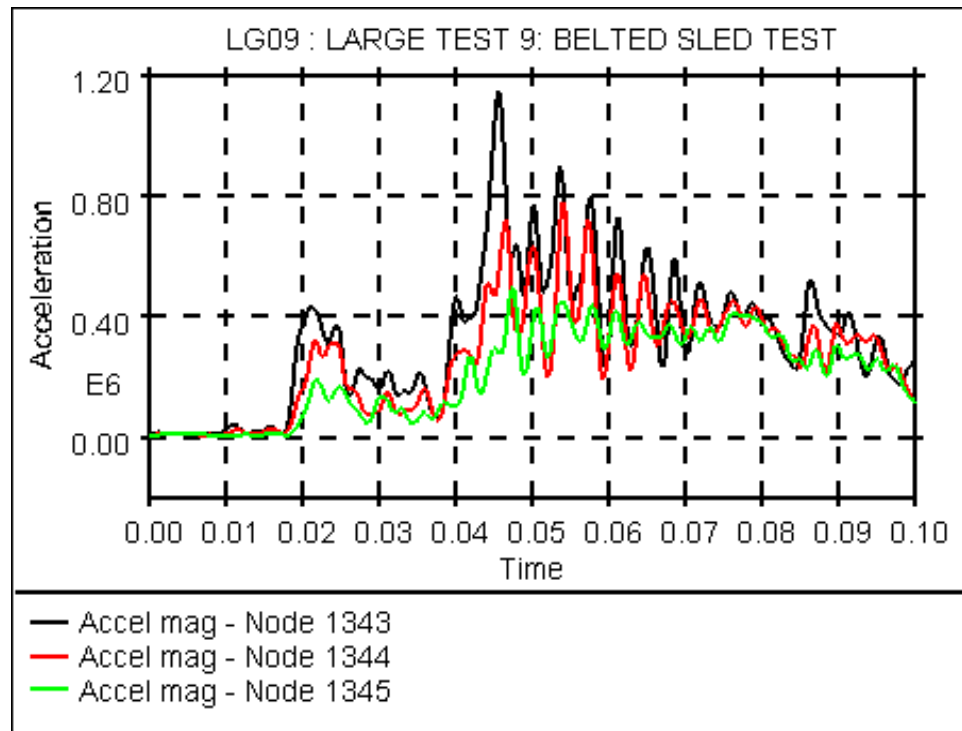
5.15.5.2 Layout

T/HIS has 4 different plotting formats as described below. The number of columns used to display the curve legends can also be set between 1 & 3. When multiple columns are used curve labels will automatically be truncated to fit the available space.

Default

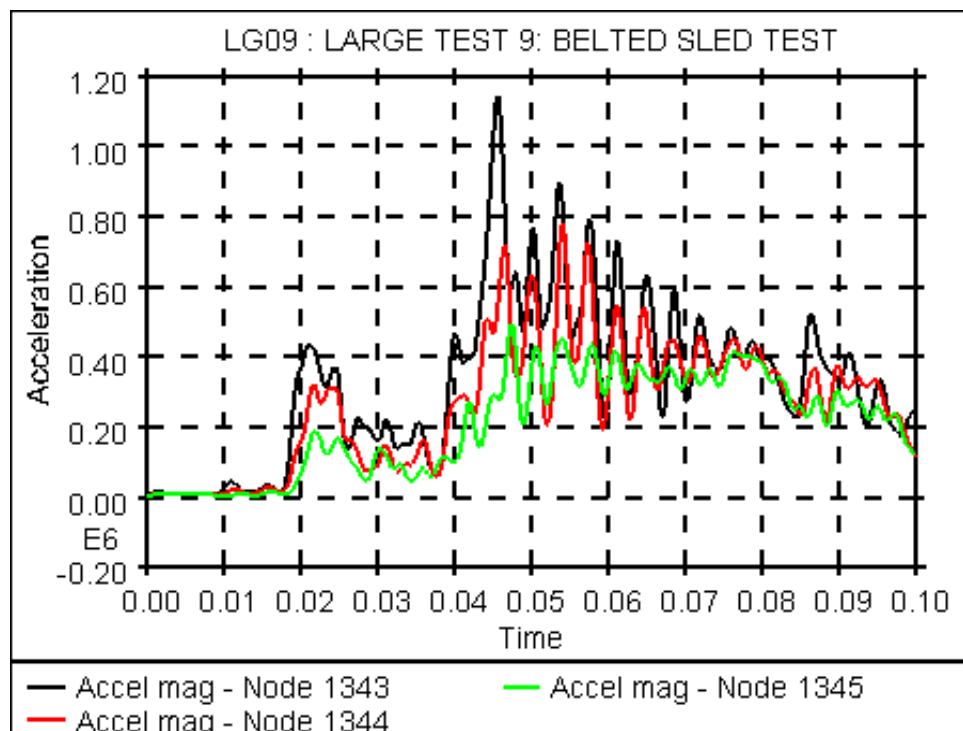
This format fixes the size of the plotting area. The maximum number of curve legends that can be displayed will depend on the font family and size selected by the user and the number of columns.

If any [USER LINES](#) have been defined then the area used to display the legend will be reduced so that the text does not cover the



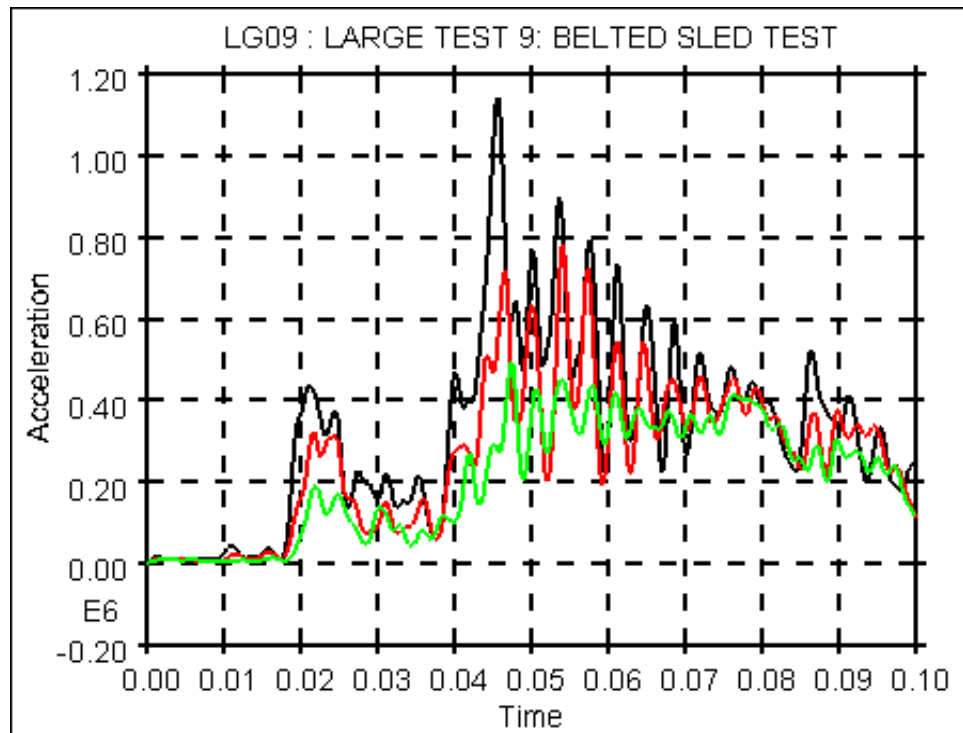
Automatic

This format automatically adjusts the plot size to maximise the plotting area while still showing a maximum of 18 line labels. Any text entered using the [USER LINES](#) option will be ignored in this plotting mode.

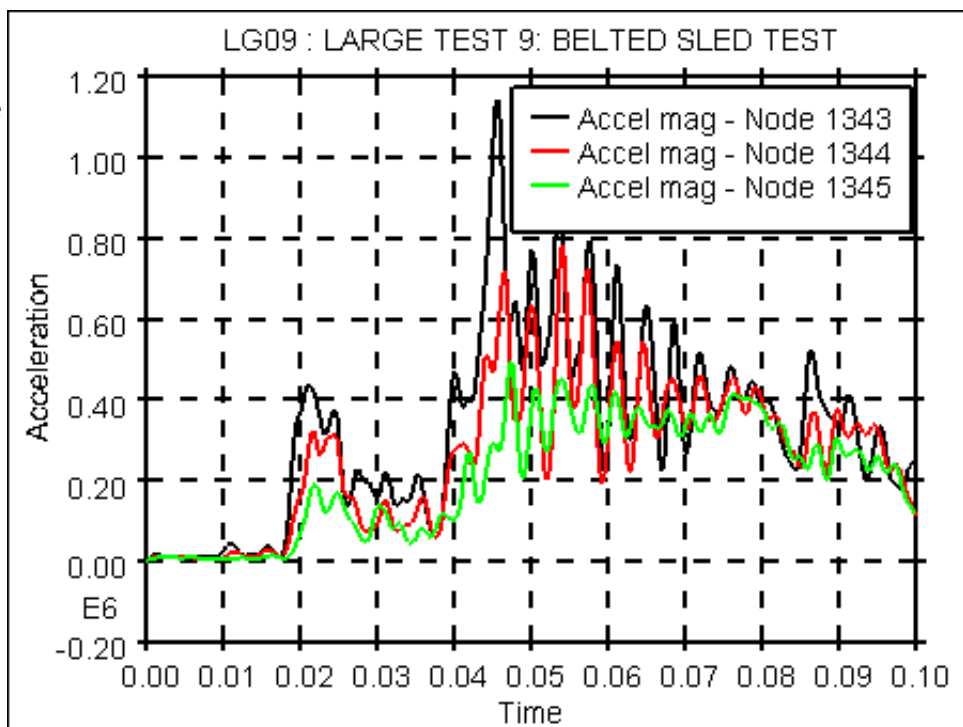


Full

This format maximises the plotting area by not showing any line labels. Any text entered using the [USER LINES](#) option will be ignored in this plotting mode.

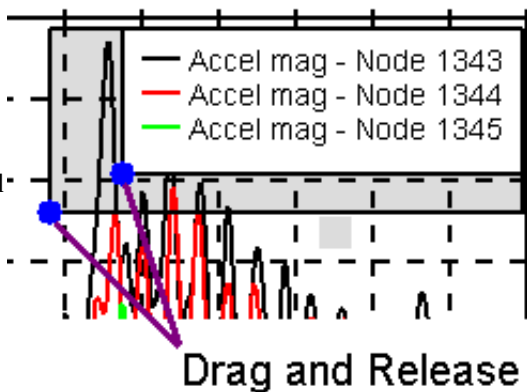
**Floating**

This format maximises the plotting area and positions the legend on top of the graph area.



The size of the legend can be modified by clicking with the left mouse button on the legend border/corner and dragging.

The legend can also be moved by clicking with the left mouse button inside the legend and dragging.



5.15.5.3 USER LINES

This option can be used to alter the default text that appears on the bottom right-hand corner of each plot. Text can be typed into any of the panels or they can be left blank. The **Size** of the text may be altered. If no text is specified the area used by the curve legends will be increased.

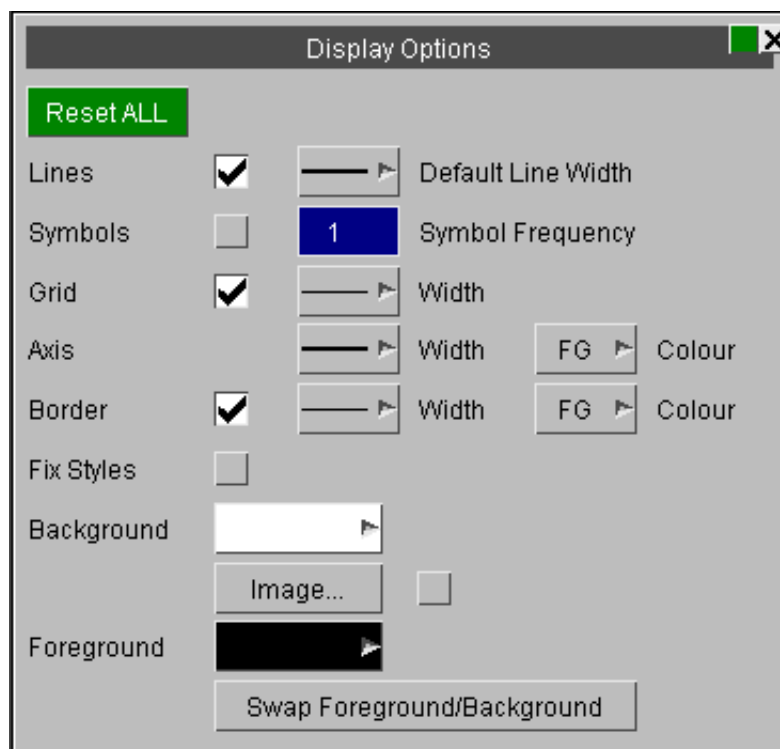
The default values are read from the "preferences" file (see [Appendix H](#) for more details).

5.16 DISPLAY Options

The **DISPLAY** menu is shown in the adjoining figure. This menu controls the overall appearance of plots.

As well as controlling basic things like the background colour and whether a grid is draw this menu also controls a number of default setting that are applied to all curves. These default setting may be overwritten for individual curves using the **CURVE CONTROL** menu ([see Section 5](#))

Changes to the Display options are only applied to active graphs ([see Section 3.5](#))



5.16.1 LINES



This is an **ON/OFF** switch for the lines between points to be drawn for all curves. The default is **ON**. The **Default Line Width** is used for all curves that have not had their widths explicitly set in the **CURVE CONTROL** menu.

The default line width can be specified in the "preferences" file (see [Appendix H](#) for more details).

5.16.3 SYMBOLS



This is an **ON/OFF** switch which controls whether symbols are plotted on top of the curves to help identify them. This option affects all the curves that are currently being used. If you wish to turn the symbols on for only some of the curves then this switch should be set to **ON** and the **CURVE CONTROL** menu should be used to turn the symbols off on the curves for which you do not want symbols drawn on. The default is **OFF**.

The **Symbols Frequency** is used for all curves that have not had a frequency explicitly set in the **CURVE CONTROL** menu. This value controls how often a symbol is drawn on a curve.

5.16.3 GRID



This is an **ON/OFF** switch which determines whether or not grid lines are shown on the plot. The default is **OFF**. The **Grid Width** can be used to change the width of the grid and axis lines.

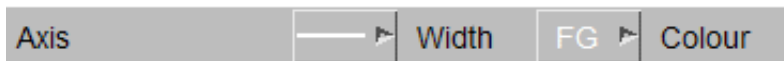
/de grid on turns grid lines on

/de grid off turns grid lines off

/de grid th 2 sets the grid thickness to 2 pixels

The default grid width and visibility can be specified in the "preferences" file (see [Appendix H](#) for more details).

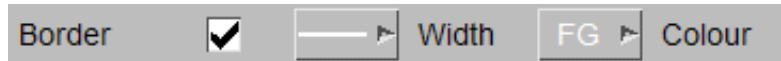
5.16.4 **AXIS**



The **Axis Width** can be used to change the width of the axis lines. The **COLOUR** button can be used to change the colour of the axis lines (see Section [5.6.2](#) for details on the available colours).

The default axis width can be specified in the "preferences" file (see [Appendix H](#) for more details).

5.16.5 **BORDER**



This is an **ON/OFF** switch which determines whether or not a border is drawn round the plot. The default is **ON**. The **Border Width** can be used to change the width of the border. The **COLOUR** button can be used to change the colour of the border (see Section [5.6.2](#) for details on the available colours).

5.16.6 **FIX LINE STYLES**



This is an **ON/OFF** switch which resets the curve styles when they are plotted on the screen so that the curves cycle through the default T/HIS colours and styles as they are plotted. This will result in the first curve being plotted always being white, the second red, the third green .etc regardless of their curve numbers. The default is **OFF**.

5.16.7 **Background**

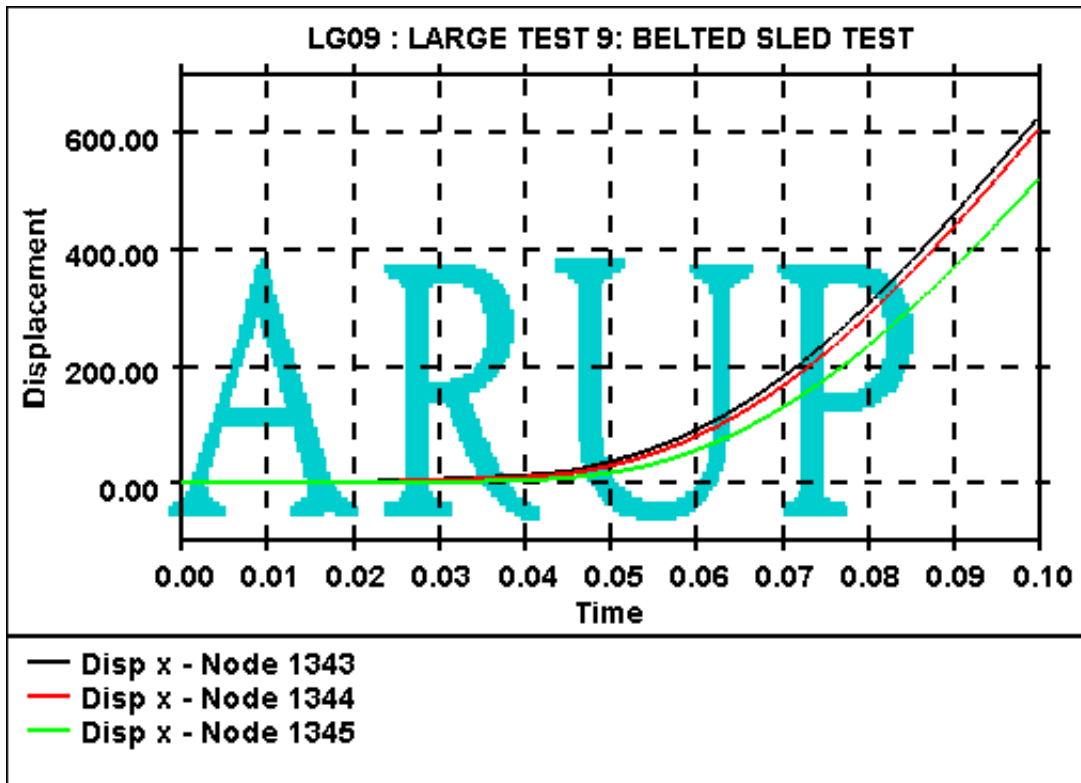
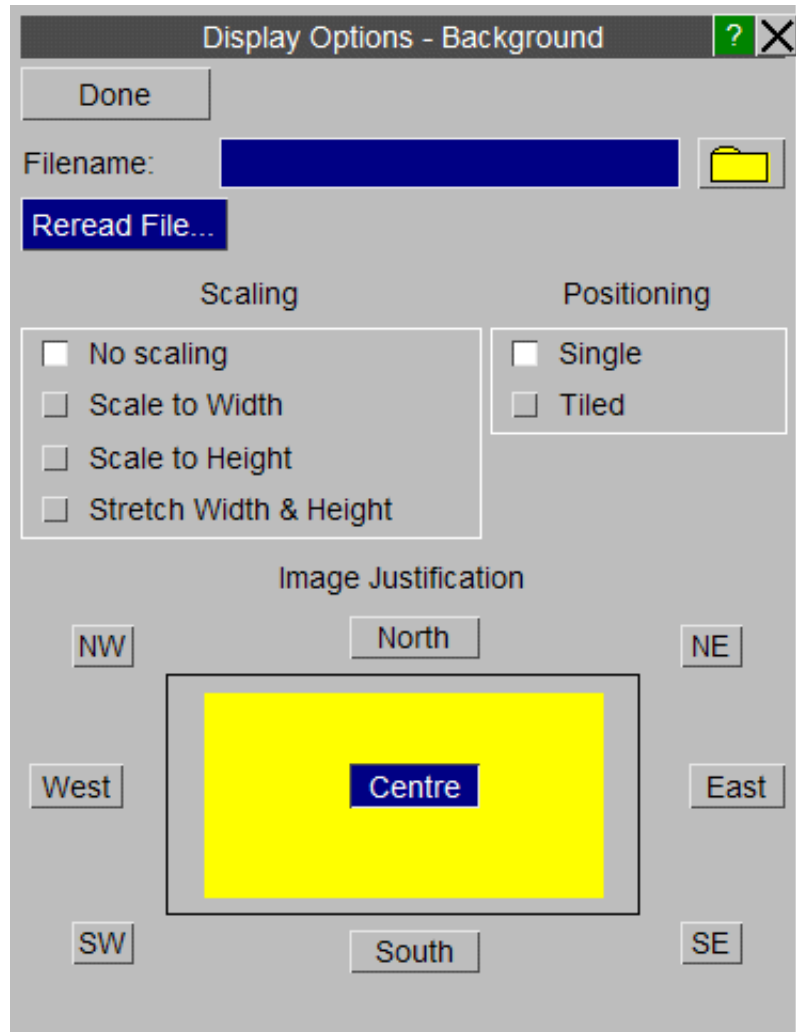


This option can be used to modify the background colour (see Section [5.6.2](#) for details on the available colours) or to set a background image. By default the background colour is set to BLACK.

Image

The IMAGE option can be used to display a background image behind a graph instead of a solid background colour.

If the image dimensions do not match the graph window dimensions then the image can be scaled to fit or it can be tiled.



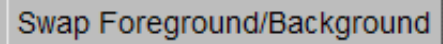
5.16.8 Foreground



This option can be used to modify the foreground colour (see Section [5.6.2](#) for details on the available colours). By default the background colour is set to BLACK and the foreground colour is set to WHITE.

Initially the grid, axes, border and labels are all set to the foreground colour.

5.16.9 Swap Foreground/Background



This option can be used to swap the currently defined foreground and background colours.

5.16.10 Display Max/Min

In versions of T/HIS prior to 9.4 the display of minimum and maximum curve values was controlled in the **DISPLAY** menu . In version 9.4 these options have been moved to the **PROPERTIES** menu (see section 5.20.21).

5.17 SETTINGS

5.17.1 Data Sources

This menu allows the user to specify their preferred order of data sources for the different data types. Upon reading in models T/HIS will read all files regardless of these preferences. When T/HIS extracts data for plotting the source is dependent on that currently set in this menu. If you select a data component or entity that is not available in the first data source T/HIS will automatically try the other data sources in order until the combination is found.

The [Model Manager](#) can be used to see what source has been used for each item for models already read into T/HIS

Settings			
Data	Files	General	Layout
	1st	2nd	3rd
Global	LSDA ▶	ASCII ▶	THF ▶
Parts	LSDA ▶	ASCII ▶	THF ▶
Nodes	THF ▶	LSDA ▶	ASCII ▶
Solids	THF ▶	LSDA ▶	
Beams	THF ▶	LSDA ▶	
Shells	THF ▶	LSDA ▶	
Tk Shells	THF ▶	LSDA ▶	
Stonewalls	XTF ▶	LSDA ▶	ASCII ▶
Springs	XTF ▶	LSDA ▶	ASCII ▶
Seatbelts	XTF ▶	LSDA ▶	ASCII ▶
Retractors	XTF ▶	LSDA ▶	ASCII ▶
Sliprings	XTF ▶	LSDA ▶	ASCII ▶
Contacts	XTF ▶	LSDA ▶	ASCII ▶
Reactions	XTF ▶	LSDA ▶	ASCII ▶
Airbags	XTF ▶	LSDA ▶	ASCII ▶
Joints	LSDA ▶	ASCII ▶	
X Sections	LSDA ▶	ASCII ▶	
Subsystems	LSDA ▶	ASCII ▶	
Geo Contacts	LSDA ▶	ASCII ▶	
Nodal RBs	LSDA ▶	ASCII ▶	
Spotwelds	LSDA ▶	ASCII ▶	
SPCs	LSDA ▶	ASCII ▶	
BOUNDARYs	LSDA ▶	ASCII ▶	
FSIs	ASCII ▶		
SPHs	LSDA ▶	ASCII ▶	

Reset

5.17.2 Files

File Names

By default the file filters in T/HIS are set to look for the file naming convention set for the LS-DYNA output files by the SHELL. This option can be used to swap the file filters back to the default LSTC naming convention. This option can be set in the [Preference File](#)

File	ARUP name	LSTC name
Time history	"jobname".thf	d3thdt
Extra Time history	"jobname".xtf	xtfile

File Output

The [HIC](#), [3ms Clip](#), [ASI](#), [THIV](#), [TTI](#) Automotive injury criteria functions and [ERR](#) operator function can all send there output to a file as well as to the screen. These options can be used to select which functions send out to a file and to specify a Root Filename that is used for all of the output files. The Root Filename can be set in the [Preference File](#)

Settings

Data

Files

General

Layout

File Names

☒ ARUP (.thf, ...)
 ☐ LSTC (d3thdt, ...)

File Output

default

Root Filename for Output

☐ Write HIC to file

E:\Software Development\V

☐ Write 3ms Clip to fil

E:\Software Development\V

☐ Write ASI to file

E:\Software Development\V

☐ Write THIV to file

E:\Software Development\V

☐ Write TTI to file

E:\Software Development\V

☐ Write ERR to file

E:\Software Development\V

THF/d3thdt File

☐ Swap Title

5

"File Skip" number

Auto

File family size (MB)

XTF/xtfile File

☐ Swap Title

5

"File Skip" number

Auto

File family size (MB)

5.17.3 General

Curve Operations

All of the [AUTOMOTIVE](#) filters are designed to filter curves using seconds as the time unit. This option can be used to automatically convert the x-axis values of any curves from milliseconds to seconds before applying one of the filters. If a curve is automatically converted then the output curve is also automatically converted back into milliseconds. This option can be set in the [Preference File](#)

All of the [AUTOMOTIVE](#) filters require curves with constant time intervals. This option can be used to specify a default time interval that will be used to automatically regularise a curve before it is filtered.

By default the [HIC](#) and [3ms Clip](#) functions calculate and report a value to the screen. These options can be used to make T/HIS display the peak values and the time windows they occur over. These options can be set in the [Preference File](#)

At present 2 different methods are used to calculate the VC injury criteria for the ECER95 and IIHS regulations (see [Appendix E](#) for more details). This option can be used to set the default value. This option can be set in the [Preference File](#)

The screenshot shows the 'Settings' dialog box with the 'General' tab selected. The 'Curve Operations' section contains the following settings:

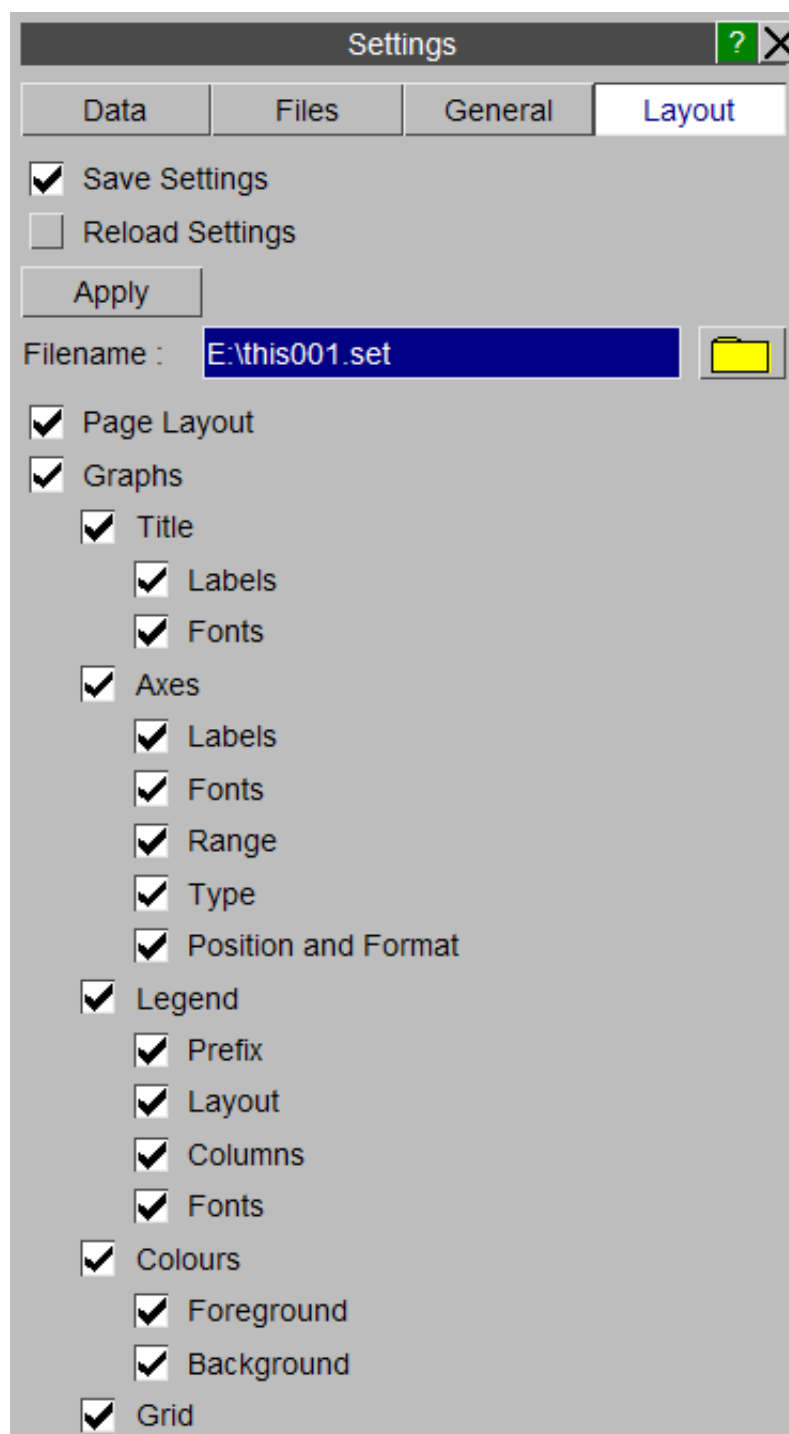
- ☐ Convert from ms->s when filtering
- ms->s time conversion: Prompt
- 0.100E-03 X axis interval for auto regularise
- ☒ Always regularise curves before filtering
- ☐ Show HIC value
- ☐ Show THIV value
- ☐ Show 3ms Clip value
- ☐ Show PHD value
- ☐ Insert (0,0) point whe
- 0.100E+19 Value to truncate curves at when rea
- VC calculation method: ☒ ECER95
- ☐ IIHS

5.17.4 Layout

Save Settings

This option can be used to save a T/HIS settings file which can be reloaded later. The settings file uses the same syntax as a FAST-TCF script except it only contains **layout** and **setup** commands.

The settings file can contain all of the commands required to reproduce the current page and graph layout or a subset of the commands.



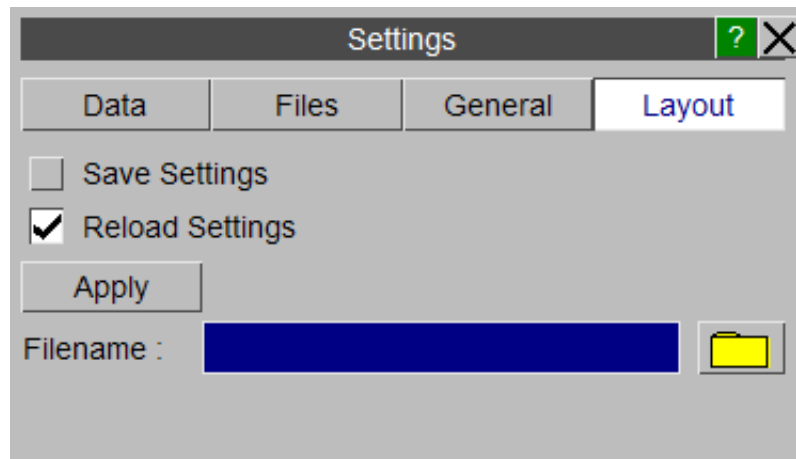
Reload Settings

This option can be used to reload a previously saved settings file. In addition to reloading a file interactively a settings file can also be specified on the [command line](#)

-set=*filename*

or via the [Preference File](#)

this*settings_file: filename



5.18 Preferences

The Preference menu provides an interactive editor for setting options for T/HIS in the oa_pref preference file (see [Appendix H](#) for more details on the oa_pref file/options)

The preferences editor reads an XML file that contains all possible preferences and their valid options, and allows you to change them at will. In this example the user is changing the background colour in T/HIS.

Note that changes made in the Preferences editor will not affect the current session of T/HIS, they will only take effect the next time it is run.

If you have write permission on the oa_pref file in the \$OASYS directory you will be asked if you want to update that file, otherwise you will only be given the option of updating your own file in your \$HOME / \$USERPROFILE directory.

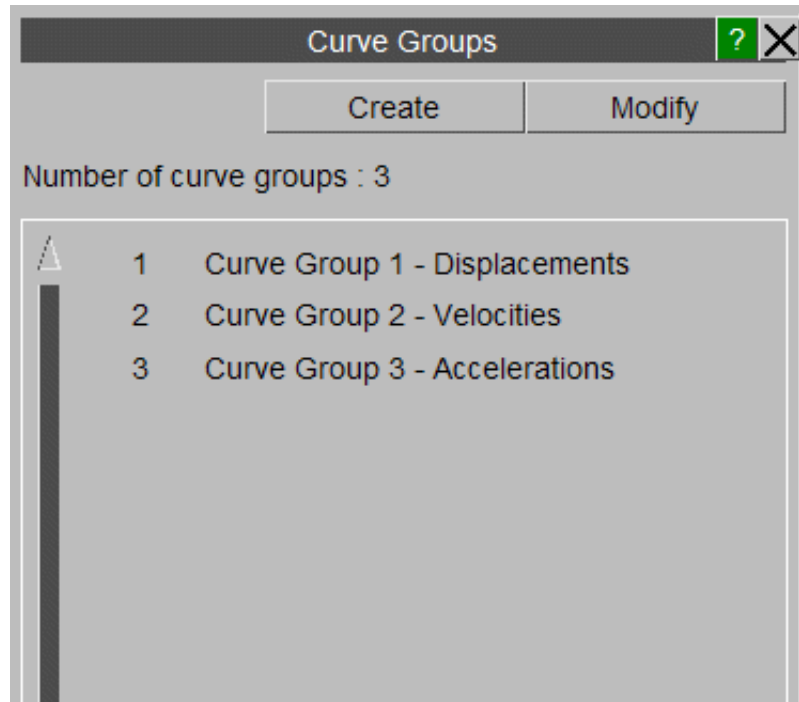
For more information on the interactive preference editor see [Appendix H](#).

5.19 Curve Groups

This panel can be used to create and modify curve groups. T/HIS can contain an unlimited number of curve groups each of which can contain any curve.

Curve groups can be used as input to most T/HIS functions that require one or more input curves ([see Section 5.0 for more details](#))

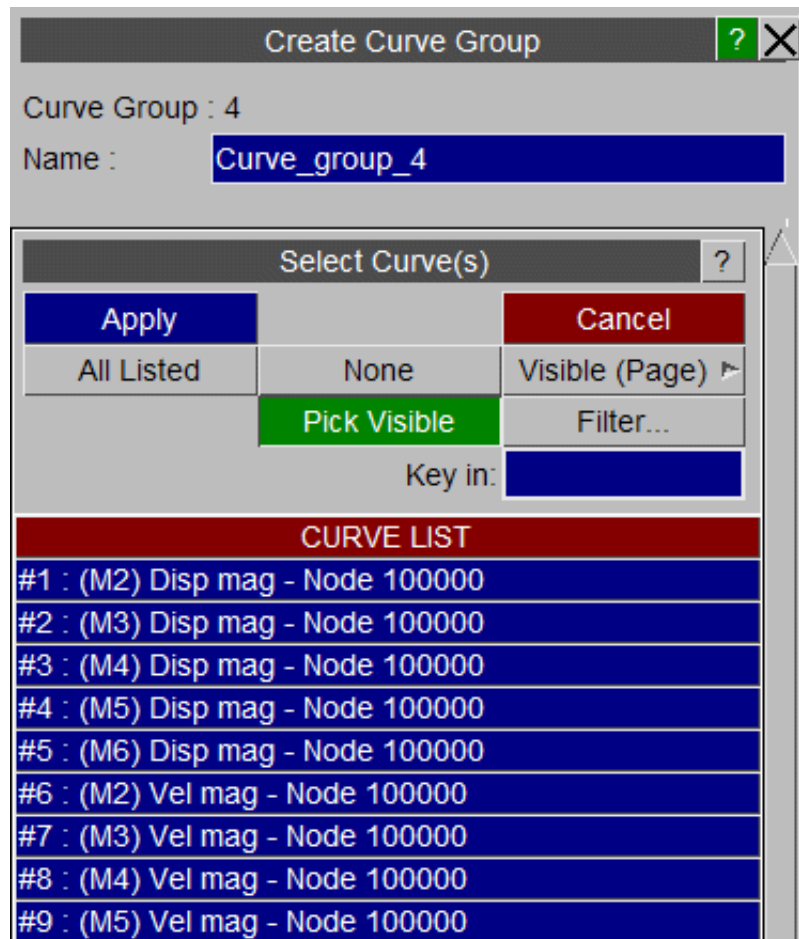
Each curve group should be given a unique name.



5.19.1 Create

This option can be used to create a new curve group.

By default the group will be called "Curve_group_#" where "#" is the curve group number if an alternate name is not specified.



5.19.2 Modify

This option can be used to modify the contents of an existing curve group or it's name.

When a curve group is selected any curves that are already defined in the group are highlighted in the curve list.

Modify Curve Group

Curve Group : 1

Name : Curve Group 1 - Displacements

Select Curve(s)

Apply

Cancel

All Listed

None

Visible (Page)

Pick Visible

Filter...

Key in:

CURVE LIST

#1 : (M2) Disp mag - Node 100000

#2 : (M3) Disp mag - Node 100000

#3 : (M4) Disp mag - Node 100000

#4 : (M5) Disp mag - Node 100000

#5 : (M6) Disp mag - Node 100000

#6 : (M2) Vel mag - Node 100000

#7 : (M3) Vel mag - Node 100000

#8 : (M4) Vel mag - Node 100000

#9 : (M5) Vel mag - Node 100000

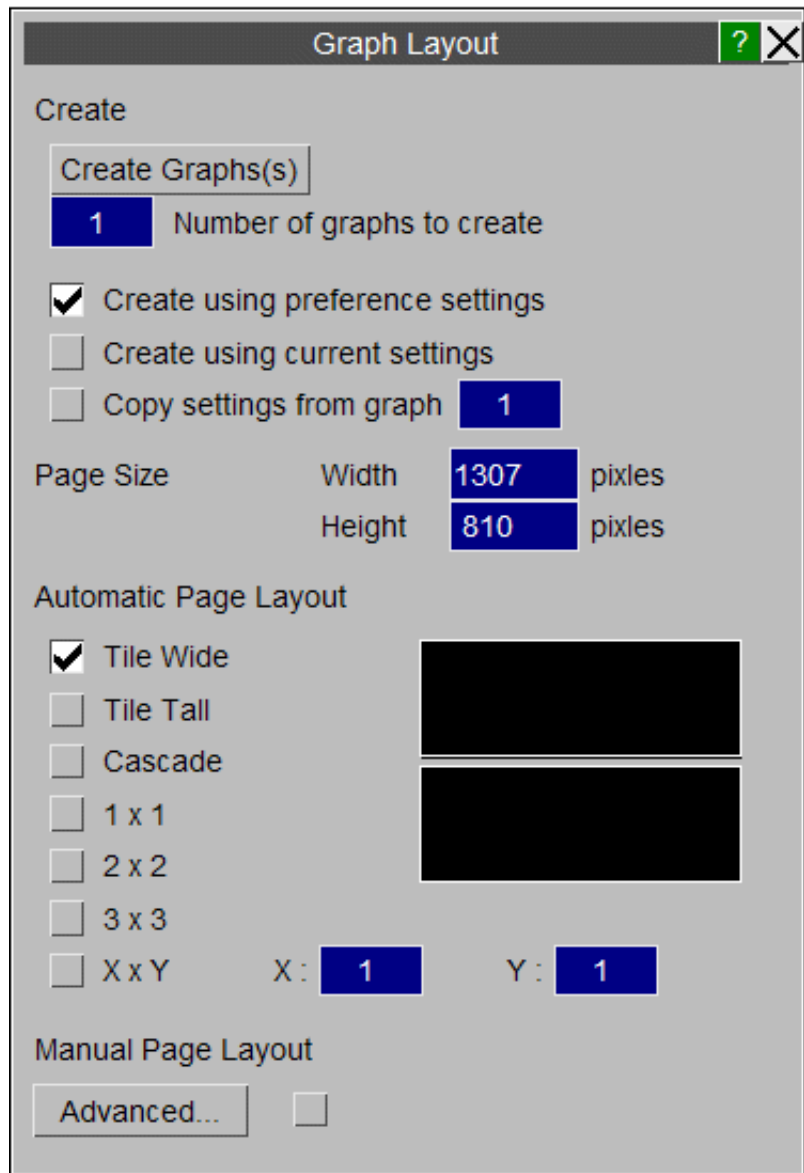
#10 : (M6) Vel mag - Node 100000

5.20 GRAPHS

This panel can be used to create additional graphs within T/HIS.

In addition to creating graphs this menu can also be used to control the layout of the graphs and to set up pages of graphs within T/HIS.

See [Section 3.0](#) for more details.



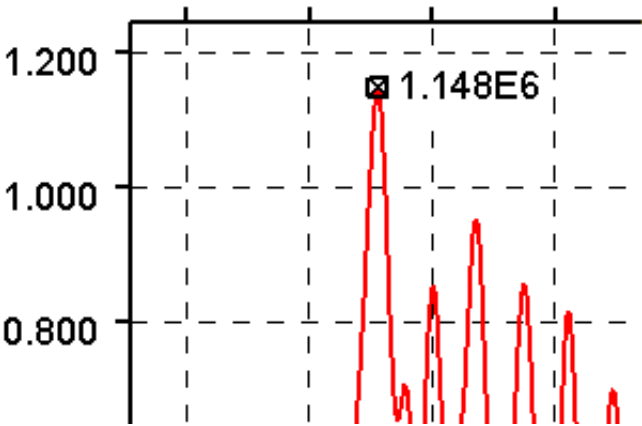
The 'Graph Layout' dialog box is shown with a title bar containing a question mark and a close button. It is divided into several sections:

- Create**: Contains a 'Create Graphs(s)' button, a numeric input for 'Number of graphs to create' set to 1, and three checkboxes: 'Create using preference settings' (checked), 'Create using current settings' (unchecked), and 'Copy settings from graph' (unchecked) with a numeric input set to 1.
- Page Size**: Includes 'Width' (1307 pixels) and 'Height' (810 pixels) inputs.
- Automatic Page Layout**: Contains checkboxes for 'Tile Wide' (checked), 'Tile Tall' (unchecked), 'Cascade' (unchecked), '1 x 1' (unchecked), '2 x 2' (unchecked), '3 x 3' (unchecked), and 'X x Y' (unchecked). To the right are two black rectangular preview areas. Below these are 'X' and 'Y' position inputs, both set to 1.
- Manual Page Layout**: Contains an 'Advanced...' button and an unchecked checkbox.

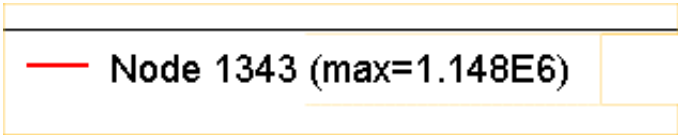
5.21 PROPERTIES

This menu can be used to display addition curves properties.

Minimum and maximum curve values can be highlighted for each curve and the value can also be displayed.



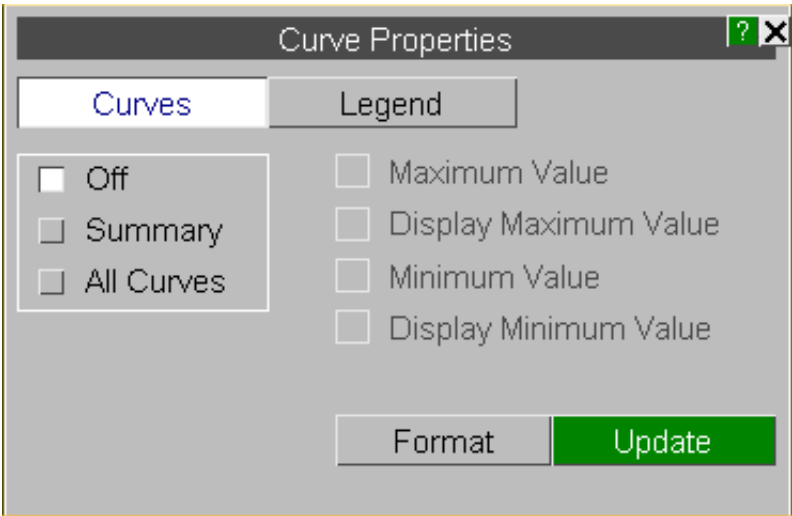
In addition to displaying the value on the curve the values can also be added automatically to the curve label in the graph legend.



5.21.1 Curves

Curves (Off)

This option will turn off the display of all minimum and maximum values.

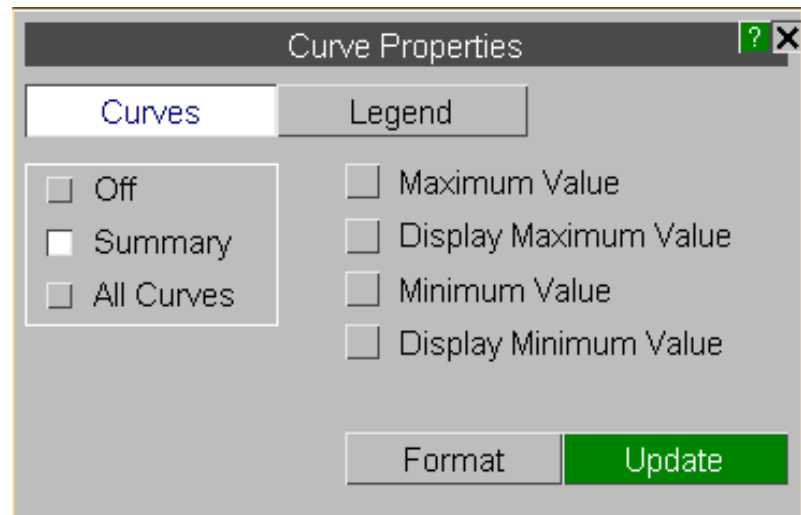


Curves (Summary)

This option will display a single minimum/maximum value from all curves currently displayed..

The following properties can be displayed

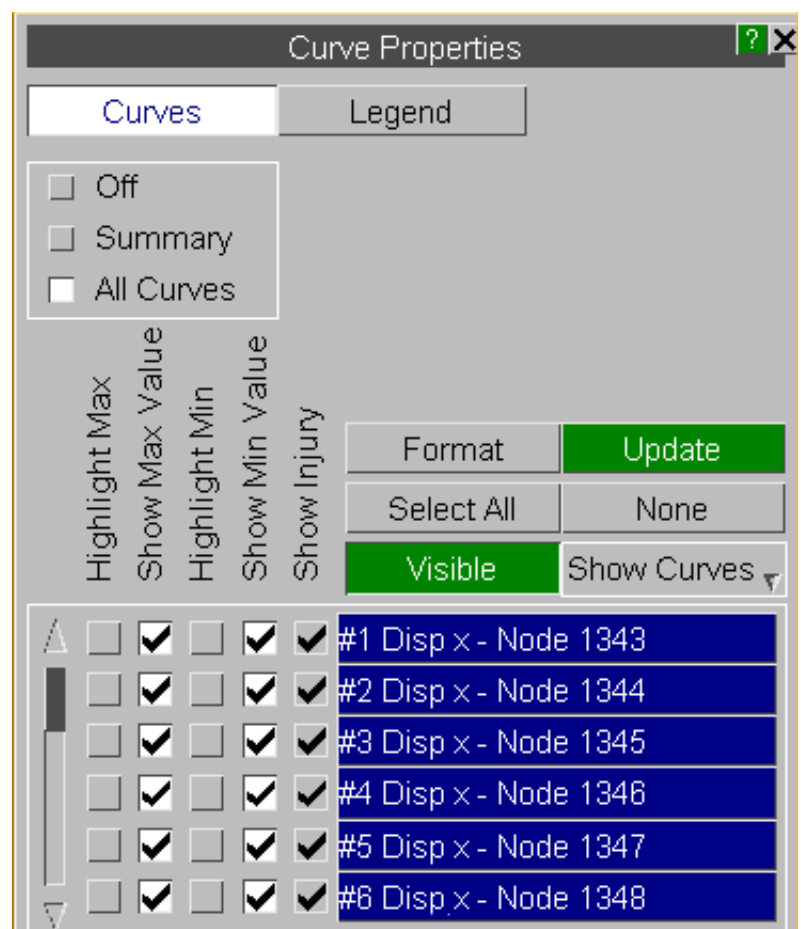
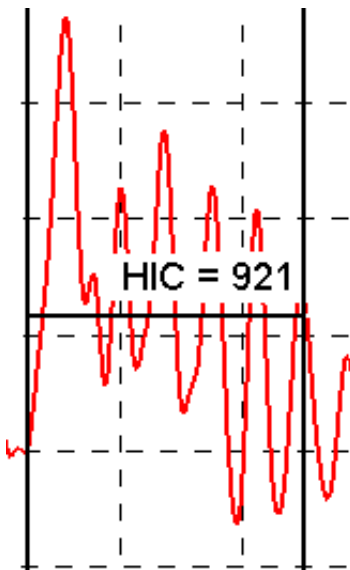
Maximum value	Mark the maximum value with a cross
Display Maximum	Display the maximum value
Minimum value	Mark the minimum value with a cross
Display Minimum	Display the minimum value



Curves (All curves)

This option can be used to select the properties that are displayed for each individual curve.

When this option is selected the display of injury criteria (HIC, HICd etc) for curves can also be selected.



5.21.3 Format

This option can be used to control the display of the minimum/maximum values on the screen.

Text

The font, font size and colour of the values can be selected. Either a single colour can be used for all the values or the values for each curve can be coloured using the same colour as the curve.

Background

To make it easier to read the values a background can also be specified. In addition to specifying the background colour a transparency value can be used to control the visibility of curves under the text.

Border and Border Colour

Specify a border and border colour to be added around the value.

Connecting Line

This option will draw a line connecting the value with the point it relates to on the curve. The connecting line is drawn using the same colour as the border.

Value

The values can be displayed showing just the Y axis value or with both the X and Y axis values. If both values are displayed they can either be displayed separated by a comma or one above the other.

Curve Properties ? X

Curves Legend

Done

Text Font: Default ▼

Text Size: Automatic ▼

Text Colour: Foreground ▼

Background Colour: Background ▼

0 Transparency 100
0

Border: ☐ On/Off

Border Colour: Foreground ▼

Border Width: — ▼

Connecting Line: ☐ On/Off

Value: ☒ Y Value Only
☐ X, Y Values
☐ X Value
☐ Y Value

Number Format: Scientific (1.2345E+2) ▼

Decimal Places: 3 ▼

Number Format

The values can be displayed using 3 different formats

Automatic	Values are displayed using exponential format, all values are displayed as values of E0, E3, E6 etc. e.g 11.234E+03
Scientific	Values are displayed using exponential format. e.g 1.123E+04
General	Values are displayed as real numbers. e.g 11234.000

Decimal Places

In addition to specifying the format, the number of decimal places can also be set between 0 and 9.

5.21.3 Legend

This option can be used to automatically added curve properties to the curve labels in the legend area.

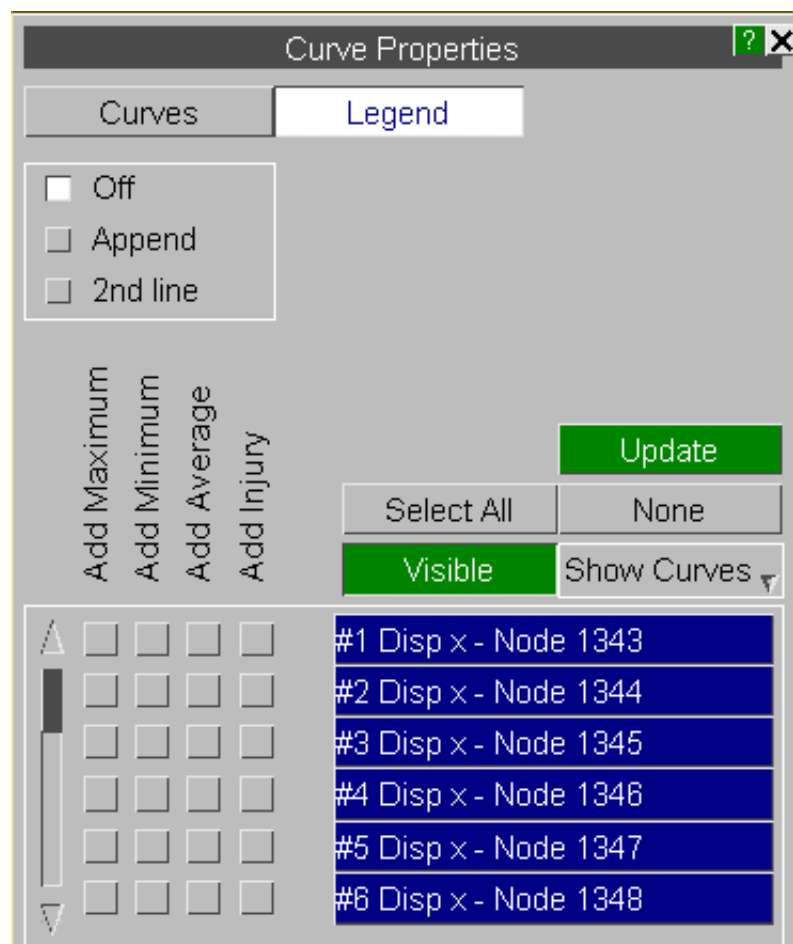
The following curve properties can be added to each curve label

Maximum value
Minimum value
Average value
Injury Criteria (HIC, HICd etc)

Other options

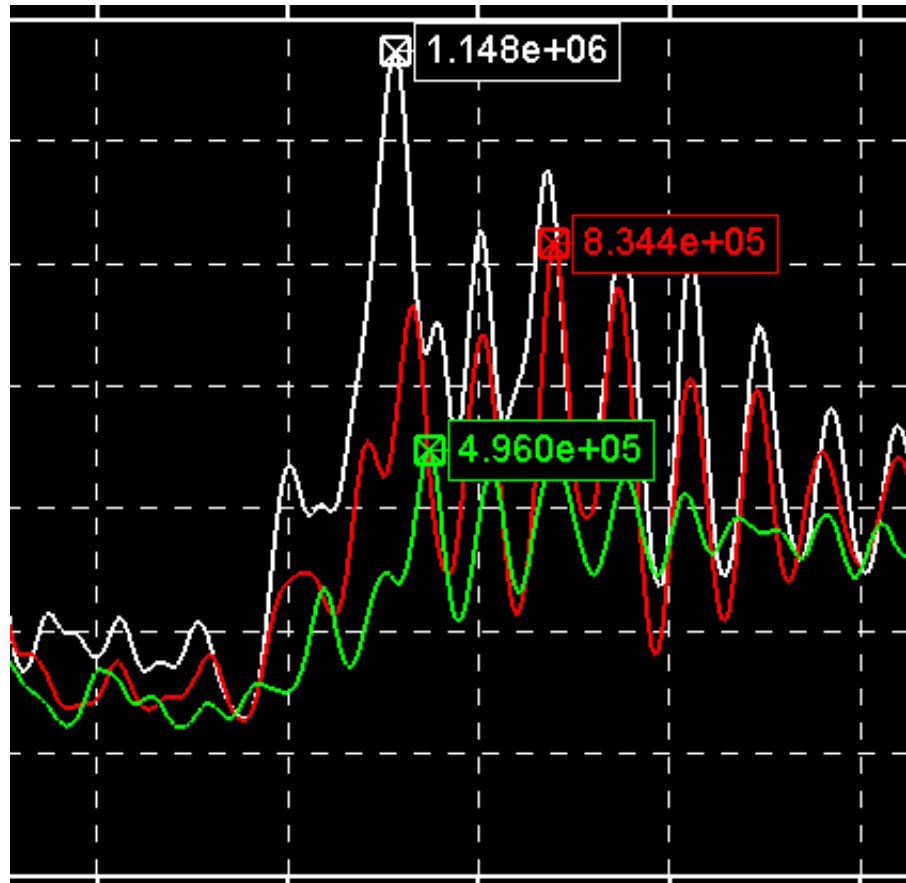
- Off** Turns off the display of curve properties in the legend
- Append** Add the values to the same line as the curve labels in the legend
- 2nd Line** Display the values using a second line for each curve in the legend

The format of the numbers added to the curve labels is the same as that used to display values on the curves.



5.21.4 Positioning Values

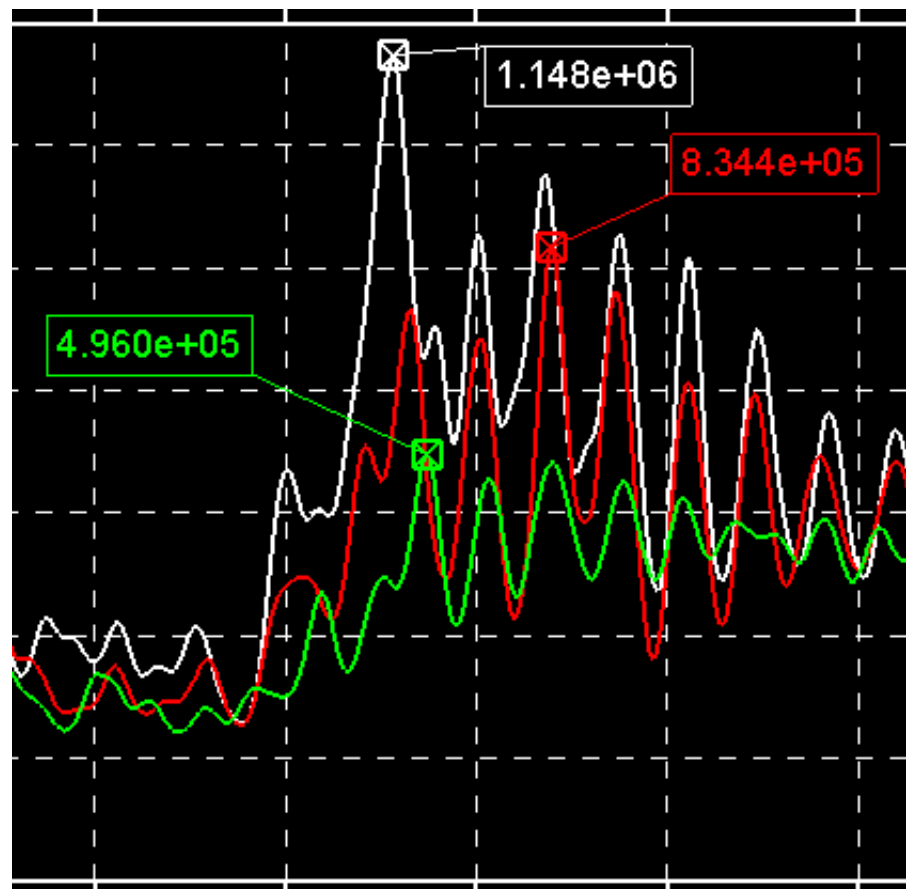
By default T/HIS will automatically position minimum and maximum values to the right of the point they apply to.



If the default location of the text obscures other curves then the position can be changed by clicking on the value with the left mouse button and then dragging the value to a new position.

If dynamic viewing is used to either zoom in or translate the curves after a value has been moved to a new position then it will maintain it's new position relative to the minimum/maximum value location.

As well as moving the minimum/maximum values the values used to display injury criteria like HIC and HIC(d) can also be moved.



5.22 UNITS

From version 9.4 onwards T/HIS tries to keep track of the units for each curves X and Y axis. For every data component that T/HIS can read from an LS-DYNA results file one of the following basic units is stored for the curves X and Y axis.

Time	Rotation	Momentum	Energy Density
Energy	Rotational Velocity	Density	Mass Flow
Work	Rotational Acceleration	Stress	Frequency
Temperature	Length	Strain	Power
Displacement	Area	Force	Thermal Flux
Velocity	Volume	Moment	Force per unit width
Acceleration	Mass	Pressure	Moment per unit width

When a curve operation is carried out on curve which has either the X or Y axis unit defined the units for the output curve(s) are also calculated. If a curve operation is carried out using 2 or more input curves with different units and the result is a curve with inconsistent units then the units are set to zero

If one of the inputs is a constant then it assumed to be unitless.

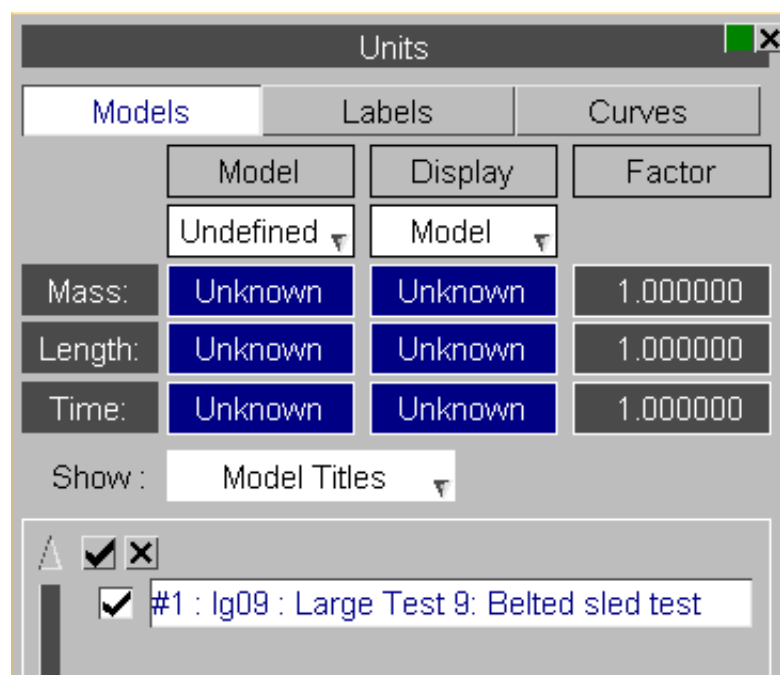
Input 1	Input 2	Operation	Output
Velocity (m/s)	Velocity (m/s)	Add	Velocity (m/s)
Velocity (m/s)	Displacement (m)	Add	Unknown
Velocity (m/s)	Velocity (m/s)	Divide	Constant
Velocity (m/s)	Displacement (m)	Divide	Frequency (1/s)
Velocity (m/s)	Constant	Add	Velocity (m/s)
Velocity (m/s)	Constant	Divide	Velocity (m/s)
Velocity (m/s)	-	Differentiate	Acceleration (m/s^2)

5.22.1 Models

By keeping track of the X and Y axis units for each curve T/HIS can now convert results from one unit system to another.

For each model one of the following 6 unit systems can be defined.

Name	Units
U1	m, kg, seconds (SI)
U2	mm, Tonnes, seconds
U3	mm, kg, milli-seconds
U4	mm, gm, milli-seconds
U5	ft, slug, seconds
U6	m, Tonnes, seconds



In addition to specifying a unit system for each model a separate unit system can also be selected to use to display results.

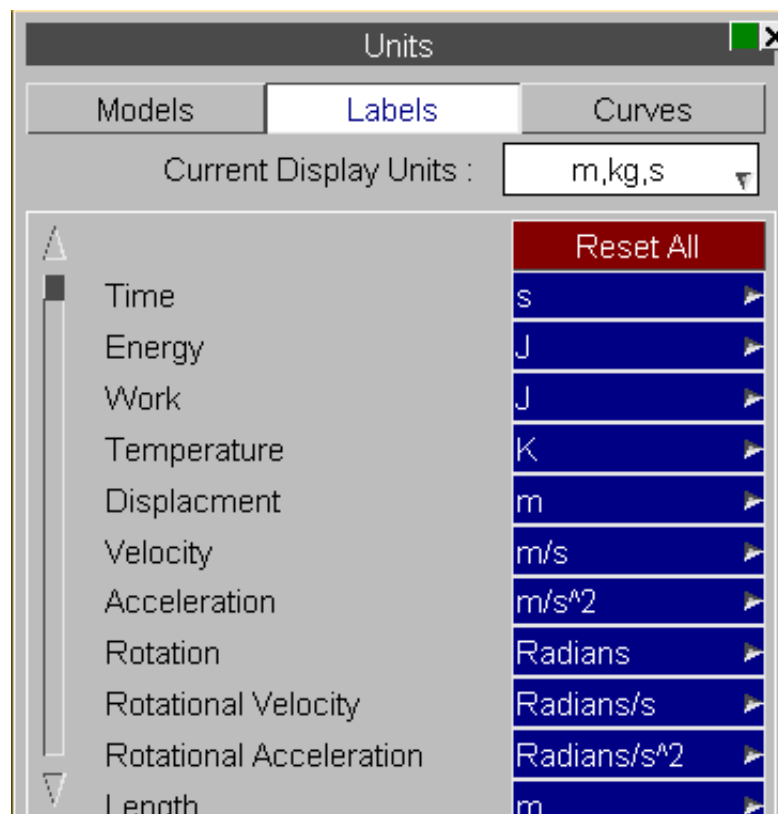
If the model unit system and the display unit system are different then T/HIS will automatically calculate the correct factors to apply to the X and Y axis as the curve data is read from the file (All curves are stored inside T/HIS using the currently defined Display unit system).

	Model	Display	Factor
	mm,T,s ▼	m,kg,s ▼	
Mass:	Tonne	Kilogram	1000.0000
Length:	mm	metre	0.001000
Time:	Sec	Sec	1.000000

5.22.2 Labels

This option will display the labels that will be used for each of the built in units. Each Unit System has it's own set of labels which can be modified if required.

The default labels for each unit system are shown below.



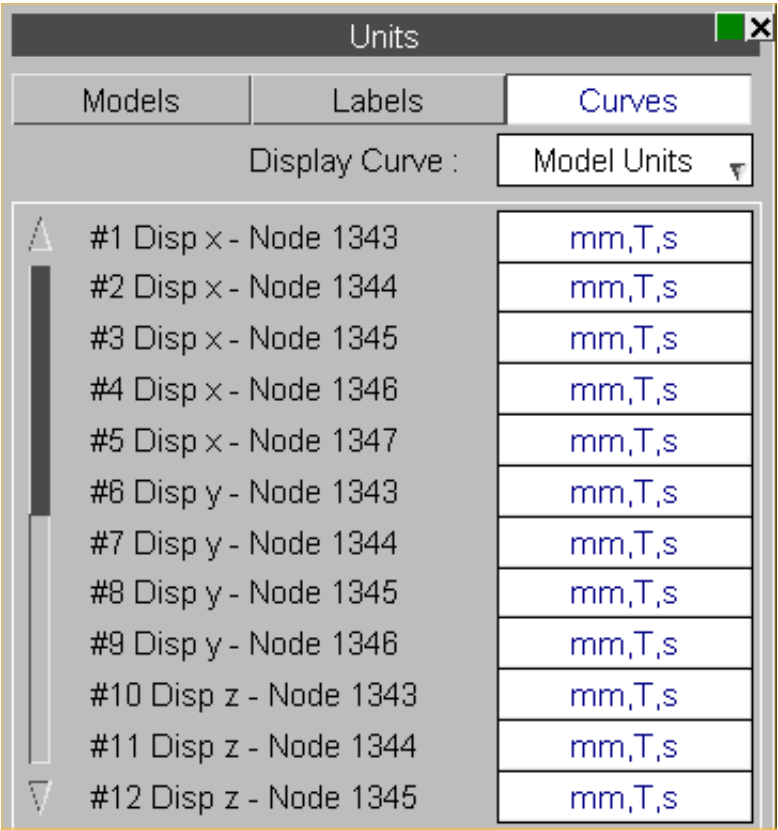
	U1: m,kg,s	U2: mm,T,s	U3: mm,kg,ms	U4: mm,gm,ms	U5: ft,slug,s	U6: m,T,s
Time	s	s	ms	ms	s	s
Energy	J	mJ	J	mJ	ft lbf	kJ
Work	J	mJ	J	mJ	ft lbf	kJ
Temperature	K	K	K	K	K	K
Displacement	m	mm	mm	mm	ft	m
Velocity	m/s	mm/s	mm/ms	mm/ms	ft/s	m/s
Acceleration	m/s ²	mm/s ²	mm/ms ²	mm/ms ²	ft/s ²	m/s ²
Rotation	Radians	Radians	Radians	Radians	Radians	Radians
Rotational Velocity	Radians/s	Radians/s	Radians/s	Radians/s	Radians/s	Radians/s
Rotational Acceleration	Radians/s ²	Radians/s ²	Radians/s ²	Radians/s ²	Radians/s ²	Radians/s ²
Length	m	mm	mm	mm	ft	m
Area	m ²	mm ²	mm ²	mm ²	sq ft	m ²
Volume	m ³	mm ³	mm ³	mm ³	cu ft	m ³
Mass	kg	T	kg	gm	slug	T
Momentum	kg m/s	T mm/s	kg mm/ms	gm mm/ms	ft slug/s	T m/s
Density	kg/m ³	T/mm ³	kg/mm ³	gm/mm ³	slug/cu ft	T/m ³
Stress	N/m ²	N/mm ²	kN/mm ²	N/mm ²	lbf/sq ft	kN/m ²
Strain	-	-	-	-	-	-
Force	N	N	kN	N	lbf	kN
Moment	Nm	Nmm	kNmm	Nmm	ft lbf	kNm
Pressure	N/m ²	N/mm ²	kN/mm ²	N/mm ²	lbf/sq ft	kN/m ²
Energy Density	J/m ³	mJ/mm ³	J/mm ³	mJ/mm ³	ft lbf/cu ft	kJ/mm ³
Mass FLOW	kg/s	T/s	kg/ms	gm/ms	slug/s	T/s
Frequency	Hz	Hz	kHz	kHz	Hz	Hz
Power	W	mW	kW	W	ft lbf/s	kW
Thermal Flux	W/m ²	mW/mm ²	kW/mm ²	W/mm ²	lbf/ft	kW/m ²
Force per unit width	N/m	N/mm	kN/mm	N/mm	lbf/ft	kN/m
Moment per unit width	Nm/m	Nmm/mm	kNmm/mm	Nmm/mm	ft lbf/ft	kNm/m

If a curve has a user defined unit or if after a curve operation one of the curve axis unit is not one of the basic units that T/HIS knows about then T/HIS will build a label from the currently defined length,mass,time,temperature and angle labels.

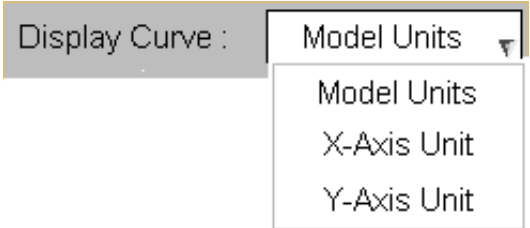
If for example a velocity/time curve is multiplied by another velocity time curve then the Y axis will have units of Velocity². If the current display unit system is U1 (m,kg,seconds) then the unit label for the curves y axis will be "m²/s²".

5.22.3 Curves

This option can be used to display the unit information for each curve.



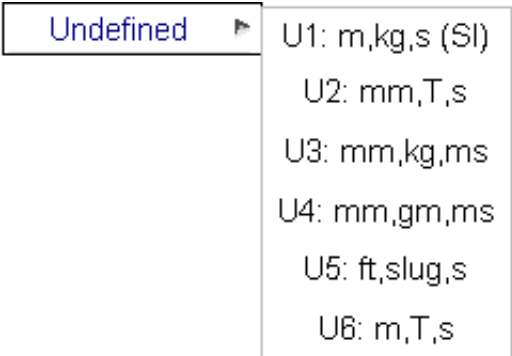
By default the unit system for each curve is displayed but his can be changed to show either the X or Y axis unit using the popup menu.



Setting the Unit System for a Curve

If the unit system for a curve has not been defined then it will be displayed as "Undefined" and a popup menu will be available that can be used to select the correct unit system. If the selected unit system is different to the unit system currently being used to display results then the curve values will automatically be converted to the current display unit system.

Note : *Once the unit system for a curve has been defined it can not be changed.*



Setting the Axis Units for a Curve

The X and Y axis units of a curve can be defined or changed at any time. The popup menu contains all of the basic Unit types that T/HIS knows about plus an option to setup a user defined unit.

To create a user defined unit for a curve the unit should be defined in terms of it's basic properties. The values for **mass**, **length**, **time**, **angle** and **temperature** should be the powers that are used to describe the unit in terms of it's fundamental dimensions.

Some examples of common units defined using this method are shown below.

Unit	Mass	Length	Time	Angle	Temperature
Time	0.0	0.0	1.0	0.0	0.0
Displacement	0.0	1.0	0.0	0.0	0.0
Velocity	0.0	1.0	-1.0	0.0	0.0
Acceleration	0.0	1.0	-2.0	0.0	0.0
Stress	1.0	-1.0	-2.0	0.0	0.0

Moment per Unit Width

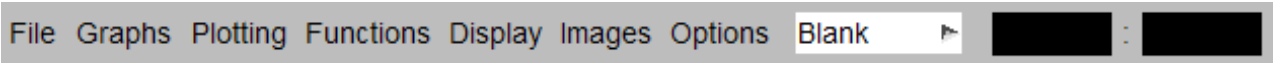
Force per Unit Width

User Defined

Unit Label :	s
Length :	0.00
Mass :	0.00
Time :	1.00
Angle :	0.00
Temp :	0.00
Apply	

6 Other Options

6.1 Tool Bar



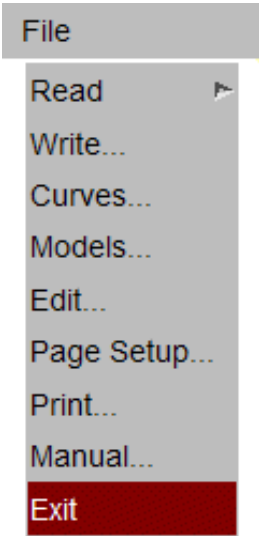
The tool bar is located across the top of the main T/HIS window and provides easy access to all of the main T/HIS menus from a series of drop down menus. In addition to the menus the drop down menus also allow a number of items to be changed dynamically and it provides a constant feedback of the cursor position within the graph area.

Each graph window contains it's own tool bar that provides a subset of the functions in the main toolbar ([see Section 6.2](#))

6.1.1 File

The File drop down menu can be used to access the following menus.

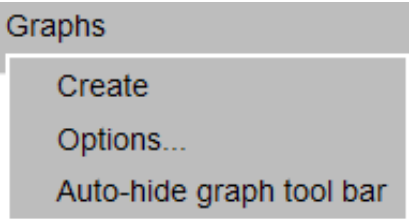
Read	see Section 5.1 for more details.
Write	see Section 5.2 for more details.
Curve Manager	see Section 5.3 for more details.
Model Manager	see Section 5.4 for more details.
Edit	see Section 5.5 for more details
Page Setup	This option is only available on PC's and can be used to access the standard Windows Page Setup menu.
Print	This option is only available on PC's and can be used to access the standard Windows Print menu.
Manual	Displays this manual.



6.1.2 Graphs

The Graphs drop down menu can be used to create new graphs and to change layout options.

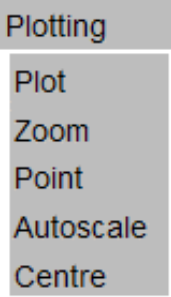
Create	Create a new graph, see Section 3.1 for more details.
Options...	Modify graph layout options, see section 3.1 for more details.
Auto-hide graph tool bar	This option can be used to automatically hide the tool bar, see Section 6.2 , at the top of each graph window.



6.1.3 Plotting

The Plotting drop down menu can be used to access the following plotting commands

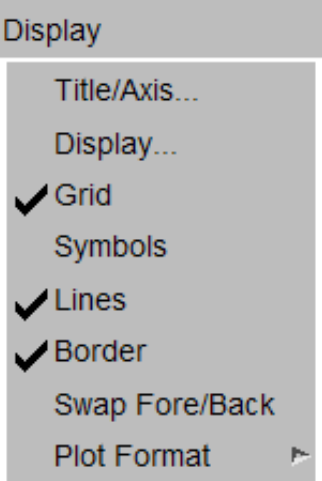
Plot	see Section 4.1 for more details.
Zoom	see Section 4.4 for more details.
Point	see Section 4.2 for more details.
Autoscale	see Section 4.5 for more details.
Centre	see Section 4.6 for more details.



6.1.4 Functions

The Functions drop down menu can be used to access all of the curve functions.

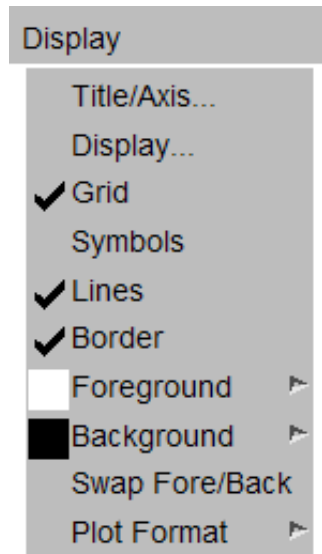
Automotive	see Section 5.11 for more details.
Operate	see Section 5.9 for more details.
Maths	see Section 5.10 for more details.
Seismic	see Section 5.12 for more details.



6.1.5 Display

The Display drop down menu can be used to access the Title/Axis and Display menus and to dynamically modify the appearance of graphs. This menu changes all of the currently active graphs ([see section 3.5](#))

Title/Axis	see Section 5.15 for more details.
Display	see Section 5.16 for more details.
Grid	Turns the grid on/off, see Section 5.16.3 for more details.
Symbols	Turns graph symbols on/off, see Section 5.16.3 for more details.
Lines	Turns graph lines on/off, see Section 5.16.1 for more details.
Border	Turns the plot border on/off, see Section 5.16.5 for more details.
Foreground	Sets the foreground colour, see Section 5.16.8 for more details.
Background	Sets the background colour, see Section 5.16.7 for more details.
Swap Fore/Back	Swaps the current foreground and background colours, see Section 5.16.9 for more details.
Plot Format	Set the current plot format, see Section 5.15.5.2 for more details.



6.1.6 Images

The Images drop down menu can be used to save the current displayed graphs as an image in a number of formats. In addition to saving an image this menu can also be used to read in an image that is used as the background for each graph.

BMP, JPEG...	Capture the image as a bitmap or JPEG, see Section 5.8.1 for more details.
Postscript	Generate a Postscript or PDF image, see Section 5.8.2 for more details.
Background	This option can be used to set an image as the background for each graph, see Section 5.8.3 for more details.

Images

BMP, JPEG ...

Postscript

Background

6.1.7 Options

The Options drop down menu can be used to access all the following functions

Command File	see Section 5.11 for more details.
Settings	Change data sources and other settings, see Section 5.17 for more details.
FAST-TCF	Generate/playback FAST-TCF scripts, see Section 5.10 for more details.
Convert LSDA>ASCII	Convert a LSDA binout file to ASCII, see Section 5.4.4 for more details.
Edit Preferences	
Menu Attributes	Modify menu fonts, size and colours, see Section 6.1.7.1 for more details.
Auto Update	Turn on/off automatic update.
Show Model Prefix	Turn the model prefix on/off or set it to automatic, see Section 5.15.5.1 for more details.
Prefix Format	Select the prefix format displayed for each model, see section 5.15.5.1 for more details.
Drag with curves	Turn on/off the display of curves when dragging axis borders and legends. On some slow machines the time taken to update the display when a large number of curves is displayed makes the dragging response too slow. This option will automatically turn off the display of curves while the dragging operation is active.
Shortcuts	Setup keyboard shortcuts for commonly used function, see section 6.4 for more details.

Options

Command File

Settings

FAST-TCF

Convert LSDA->ASCII

Edit Preferences

Menu Attributes

✓ Auto Update

(A) Show Model Prefix ▶

Prefix Format ▶

✓ Drag with curves

Shortcuts

6.1.7.1 MENU Attributes

This panel allows you to tune the visual attributes of the screen menus within T/HIS and save them if you wish.

Dismiss Save_Settings HELP

Display Factor 1.50 0.5 (larger) .. 2.0 (smaller)

Font size: ☐ Small ☒ Default ☐ Large

Font typeface: Helvetica

Brightness 1.00 Menu brightness: 0.0 .. 1.

Saturation 1.00 Menu saturation: 0.0 .. 1.0

Left handed: ☐ None ☐ Mouse ☐ Shift & Ctrl ☐ All

Left handed support swaps left and right mouse buttons and/or <shift> and <ctrl> keys or all of these

Display Factor

Lies in the range 0.5 to 2.0, default 1.0. Values < 1.0 reduce the apparent size of the screen so that menus and text become larger. Values > 1.0 act in the opposite sense. This is the simplest way of taking into account the display size.

Font Size

Sets the font size independently of the display scale, face which can be useful on wide-screen displays. The font typeface can also be changed.

Font typeface
Helvetica Normal
Helvetica Bold
Times Normal
Times Bold
Courier Normal
Courier Bold

Brightness

Lies in the range 0.0 to 1.0, default 1.0. Controls the brightness of the menu interface only (it will not affect displayed graphics).

Saturation

Lies in the range 0.0 to 1.0, default 1.0. Controls the colour saturation of the menu interface. (Again it will not affect displayed graphics.)

Left Handed

The software uses mouse buttons and keyboard 'meta settings keys (<shift> & <control>) in a handed way that is set up by default for right-handed use. It is possible to configure either or both for left-handed use.

Save Settings

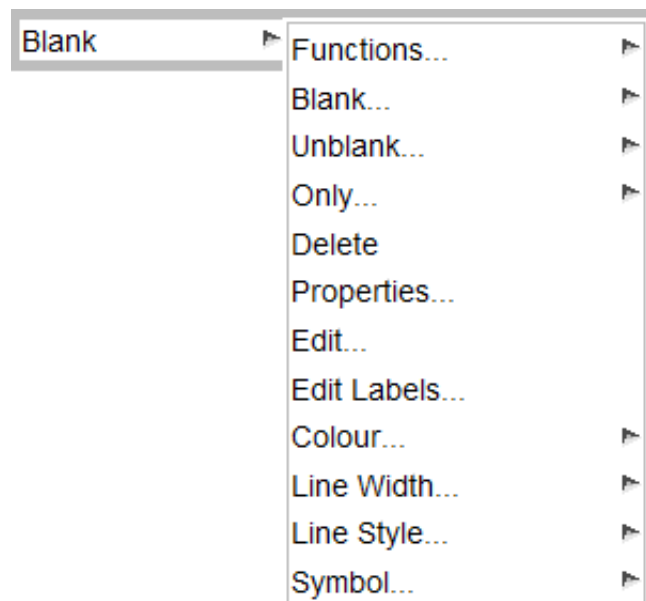
Once you have adjusted the above to your taste you can save these settings in your 'oa_pref' file for future use with the **Save_Settings** button. If you do not save settings they will be lost when this session exits.

6.1.8 Quick Pick

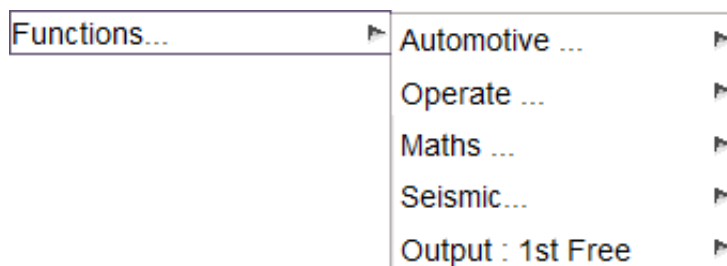
The Quick Pick menu can be used to perform many common curve operations using just the mouse. The current "Quick Pick" mode is displayed on the tool bar and can be changed using the popup menu.

The current "Quick Pick" option can be applied to a single curve by selecting the curve using the left mouse button. Multiple curves can be selected by holding down the left mouse button and dragging out an area.

Some functions can be undone using the middle mouse button.



6.1.8.1 Functions...



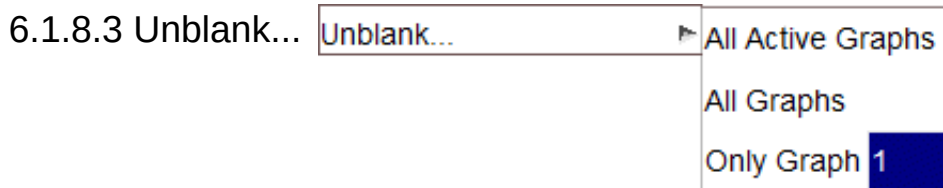
This option can be used to select any of the curve operations (see Sections [5.9](#), [5.10](#), [5.11](#) and [5.12](#)) that have a single curve as input. In addition to selecting a curve operation this menu can also be used to set the output curve for the curve operation to either the 1st free curve or to overwrite the input curve.

This option can be applied to multiple curves but it can not be undone.



This option can be used to blank curves. The selected curves can be blanked in just the graph they were selected in, all the currently active graphs or all graphs.

This option can be applied to multiple curves and it can be undone using the middle mouse button.



This option can be used to unblank curves. The selected curves can be unblanked in all the currently active graphs, all graphs or a individual graph can be specified.

This option can be applied to multiple curves and it can be undone using the middle mouse button.



This option can be used to blank all curves except for the selected ones. The selection can be applied to just the graph they were selected in, all the currently active graphs or all graphs.

This option can be applied to multiple curves and it can be undone using the middle mouse button.

6.1.8.5 Delete

This option can be used to delete curves. It can be applied to multiple curves but it can not be undone.

6.1.8.6 Properties...

This option will display the current properties for a curve (see Section [6.3.1](#) for more details). If multiple curves are selected this option is only applied to the one with the lowest curve ID.

6.1.8.7 Edit...

This option can be used to select a curve for editing (see Section [5.5](#) for more details). If multiple curves are selected this option is only applied to the one with the lowest curve ID.

6.1.8.8 Edit Labels...

This option can be used to edit the label, title and axis labels for a curve (see Section [6.3.2](#) for more details) . If multiple curves are selected this option is only applied to the one with the lowest curve ID.

6.1.8.9 Colours...

This option can be used to change the colour of curves. This option can be applied to multiple curves and it can be undone using the middle mouse button.

6.1.8.10 Line Width...

This option can be used to change the line width of curves. This option can be applied to multiple curves and it can be undone using the middle mouse button.

6.1.8.11 Line Style...

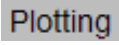
This option can be used to change the line style of curves. This option can be applied to multiple curves and it can be undone using the middle mouse button.

6.1.8.12 Symbols...

This option can be used to change the symbol style of curves. This option can be applied to multiple curves and it can be undone using the middle mouse button.

6.2 Graph Tool Bar

 This option can be used to make a graph active or inactive, [see section 3.5](#) for more details.

 This option provided the same functions as the [Plotting](#) menu in the main toolbar with the exception that the settings only apply to the graph in the window instead of all of the currently active graphs.

 This option provided the same functions as the [Display](#) menu in the main toolbar with the exception that the settings only apply to the graph in the window instead of all of the currently active graphs.

6.3 CURVE INFORMATION

Pressing the right mouse button while in the graphics window will display a popup menu listing the ID, label and the data source of the nearest curve.

When data is read from either one of the LS-DYNA output files T/HIS will store the ID and type of the entity that the data applies to. If the curve label is modified this data will remain unchanged so that the curve source can still be identified.

If a curve has been read in from another source then T/HIS will report the data source as being "UNKNOWN"

If a curve is created from another curve using one of the T/HIS curve operations then the data source for the new curve will be copied from the original curve. If the operation uses more than one curve as input then the data source information will only be copied to the new curve if all of the input curves had the same data source.

Edit will open the curve editor for the selected curve whilst the colour, Line Width, Line style and Symbol pop-up menus allow the user to change these options for the curve (as can be done from the **STYLE** menu).

Model ID : #1
NODE : 1343
File : THF
Disp x - Node 1343
Functions...
Blank...
Unblank...
Only...
Delete
Properties...
Units...
Edit...
Edit Labels...
Colour...
Line Width...
Line Style...
Symbol...
Dismiss

6.3.1 Properties...

This option displays a number of properties for a curve including minimum and maximum values, average and RMS value.

Xmin	0.0000000	
Xmax	0.0998993	
Ymin	0.0000000	@ X = 0.0000000
Ymax	1217170.8	@ X = 0.0479982
RMS	343394.38	
Average	271682.56	

6.3.2 Edit Labels...

This option can be used to change the title, tag, line label and axis labels for a curve.

Line Label Accel mag - Node 1348
Title LG09 : LARGE TEST 9: BELTED SLE
X-Axis Time
Y-Axis Acceleration
Tag
Apply

6.3.3 Functions...

The functions popup menu can be used to access any of the curve operations that take a single curve as the only input. As well as applying an operation to a curve this menu can also be used to select between.

- Overwriting the input curve with the output from each function
- Writing the output to the 1st unused curve

Automotive ...
Operate ...
Maths ...
Seismic...
Output : 1st Free

6.4 Keyboard Shortcuts

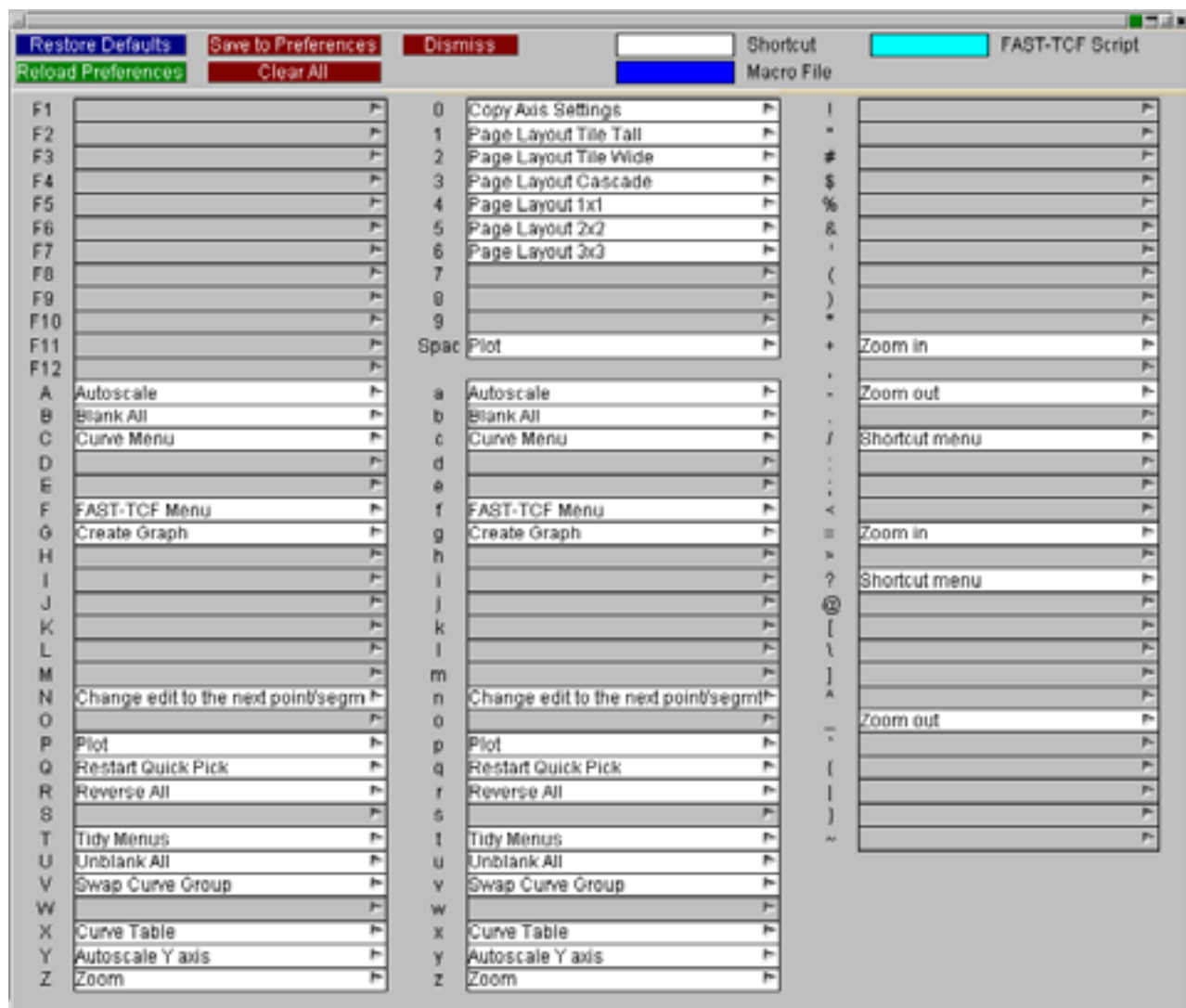
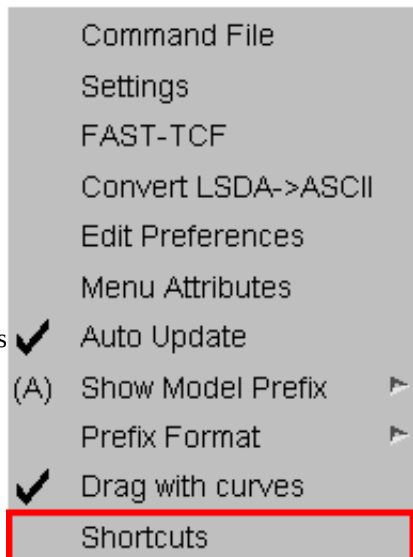
Some panels and actions can be accessed through pre-programmed shortcuts and from v9.4 the keys they are assigned to are customizable.

In V9.4 a number of new pre-programmed shortcuts have been added, including the top menu panels and window layout options. Macros and FAST-TCF scripts can also be assigned to a key.

A listing of the available shortcuts and the keys they are assigned to can be brought up by pressing the '?' key (by default) or accessing it through the Options top menu.

This will bring up a panel, from which you may assign the shortcuts, Macros and FAST-TCF scripts to the keys. Note that upper and lower case letters can be assigned different shortcuts.

A list of all the available pre-programmed shortcuts is given at the end of this section with their default key(s) if assigned.



At the top of the panel you will see the following buttons.

Restore Defaults

Restores the shortcuts to their default keys, removing any shortcuts assigned by the user.

Save to Preferences

Saves the shortcuts to the oa_pref file in the home directory. They are saved in the format "this*A_key: AUTOSCALE" where the first part defines which key the shortcut is assigned to and the second part is the shortcut being assigned. Each shortcut has a specific name to use in the oa_pref file, and a list is given below.

When T/HIS is started this is read and the saved shortcuts are restored.

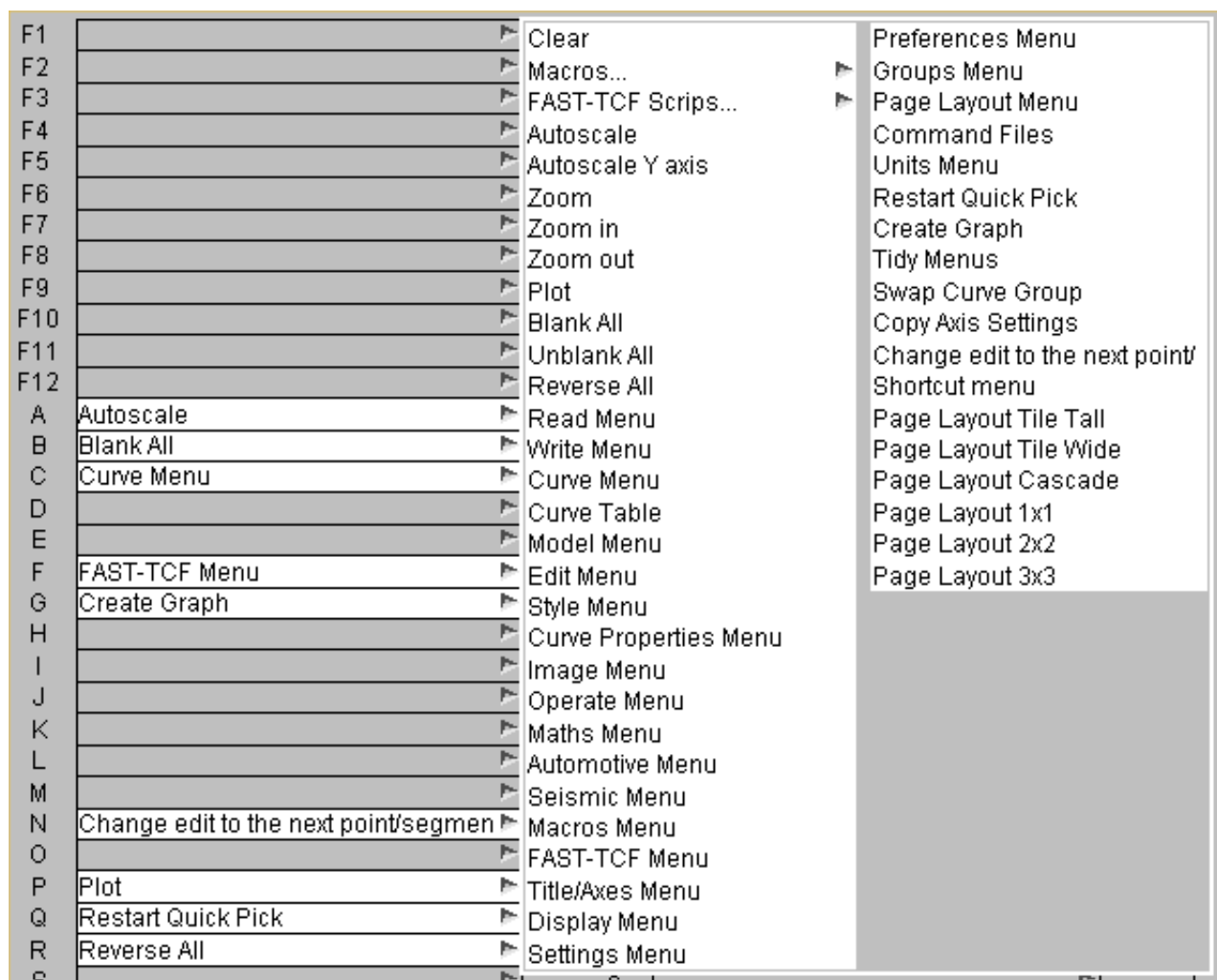
Reload Preferences

Reloads the shortcuts from the oa_pref file in the home directory.

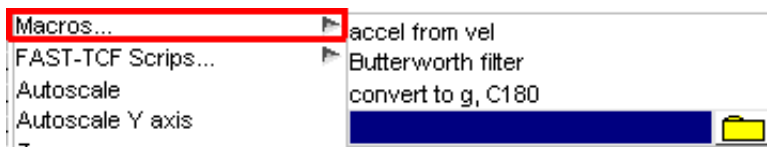
Clear All

Clears all the shortcuts on the panel.

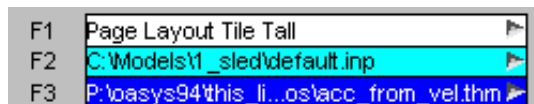
To assign a shortcut, right click on the key you want to assign it to. This will bring up a list of all available shortcuts in T/HIS as well as the option to assign Macros or Fast-TCF scripts.



To assign a Macros or Fast-TCF script to a key, right click on "Macros..." or "FAST-TCF Scripts...". This will bring up another popup from which you can select the Macro or Fast-TCF script. The popup will contain a list of Scripts that D3PLOT has picked up from the \$OASYS and home directory. If the script you want is not in this list you can browse for it by clicking on the folder icon.



The listing of assigned keys is colour coded to easily distinguish between pre-programmed shortcuts (white), Fast-TCF scripts (light-blue) and Macros (dark-blue).



Pre-programmed Shortcuts: Defaults shown in bold, oa_pref name shown in brackets

View Controls	
A/a - Autoscale (AUTOSCALE)	Autoscale Y axis (Y_AUTOSCALE)
P/p - Plot (PLOT)	[SPACE] - Plot (PLOT)
Z/z - Zoom (ZOOM)	"+"/"= - Zoom in (ZOOM_IN)
"-"/"_ - Zoom out (ZOOM_OUT)	
Blanking	
B/b - Blank All (BLANK)	R/r - Reverse curve blanking (REVERSE)
U/u - Unblank all curves (UNBLANK)	
Menus	
Automotive Menu (AUTOMOTIVE_MENU)	Command Files Menu (CFILE_MENU)
C/c - Curve Menu (CURVE_MENU)	Curve Properties Menu (PROP_MENU)
Curve Table (CURVE_TABLE)	Display Menu (DISPLAY_MENU)
Edit Menu (EDIT_MENU)	Groups Menu (GROUPS_MENU)
Image Menu (IMAGE_MENU)	F/f - FAST-TCF Menu (FAST_TCF_MENU)
Macros Menu (MACROS_MENU)	Maths Menu (MATHS_MENU)
Model Menu (MODEL_MENU)	Operate Menu (OPERATE_MENU)
Page Layout Menu (PAGE_MENU)	Preferences Menu (PREF_MENU)
Read Menu (READ_MENU)	Shortcut Menu (SHORTCUT)
Seismic Menu (SEISMIC_MENU)	Settings Menu (SETTINGS_MENU)
Style Menu (STYLE_MENU)	Title/Axes Menu (TITLE_MENU)
Units Menu (UNITS_MENU)	Write Menu (WRITE_MENU)

Page Layout	
1 - Page Layout Tile Tall (TILE_TALL)	2 - Page Layout Tile Wide (TILE_WIDE)
3 - Page Layout Tile Cascade (CASCADE)	4 - Page Layout Tile 1x1 (LAYOUT_1X1)
5 - Page Layout Tile 2x2 (LAYOUT_2X2)	6 - Page Layout Tile 3x3 (LAYOUT_3X3)
Miscellaneous	
G/g - Create a new graph Window (NEW_WINDOW)	T/t - Tidy Menus (TIDY_MENUS)
V/v - Change Curve Picking Group (CURVE_GROUP)	Q/q - Swap to Quick Pick (QUICK_PICK)
PAGE UP - Next Page	PAGE DOWN - Previous Page
HOME - First Page	END - Last Page
Change edit to next point (EDIT_NEXT)	0 - Copy Axis Settings (COPY_AXIS)

7 FAST-TCF

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7.0 FAST-TCF OVERVIEW

FAST-TCF is a scripting language for T/HIS. It is designed to be editable and backward-compatible with previous versions of T/HIS. From version 9.2 FAST-TCF scripts can be recorded and played back in T/HIS. The FAST-TCF scripts are plain text files, and are therefore easy to edit and manipulate.

7.0.1 NEW FEATURES

New Features for FAST-TCF version 9.3

FAST-TCF scripts from version 9.2 of T/HIS are compatible with version 9.3.

Because of the multiple graphs and pages available in T/HIS 9.3 additional commands have been added to FAST-TCF 93 to define and position graphs and to generate multiple images containing one or more graphs. Because of these new commands version 9.3 FAST-TCF scripts generated by T/HIS can not be used in previous releases.

- [New commands have been added for generating and positioning multiple graphs and pages.](#)
- [New commands for generating images containing multiple graphs and pages.](#)
- [New variables have been added for accessing the output values of the ERR command.](#)
- [New built in variables "\\$run_nameN", "\\$run_titleN" and "\\$run_dirN" for multiple models.](#)
- [New built in variable "\\$FTCF_PATH"](#)

New Features for FAST-TCF version 9.2

FAST-TCF has been extensively revised to include almost all of the T/HIS commands. The improved functionality does mean that old scripts may have to be changed to meet the new standards.

NOTE: FAST-TCF is not 100% compatible with pre-version 9.1 input scripts:

- [Variables have changed to allow more flexibility, but the old rule for filenames \(word1 + word2\) has now been discontinued, filenames must all be one word](#)
- [Rigidwall command must now have "n" for the xtf file output \(rather than nothing at all\)](#)
- [Shell and Solid effective strain must have the fourth word "eff" to distinguish them from other types of strain that have been added](#)
- [No FAST-TCF defaults for plot setup - defaults are now the T/HIS standard ones](#)

New features since version 9.1:

- [Reading of keyword, csv, csv2, and bulk data files, keyboard entry](#)
- [Operation commands "order", "cat", "r_ave", "stress", "logx", "logx10", "translate", "vector2D", "window"](#)
- [Variables are processed on a line by line basis](#)
- [Variables can be defined using curve properties - for example a variable could be set to equal max of a curve, and then used to divide another curve](#)
- [Continuation lines added - defined using a "\" at the very end of a line](#)

- Tabulation commands "yatmax" and "yatmin" added for Y values at maximum and minimum X
- [All extraction commands are supported: Boundary, Geo contacts, FSI, Joints, SPH, Thick shells and so on](#)
- [All the missing components for previous data types are now supported](#)
- [Multiple data extraction on one line e.g. "node 100:last acc X"](#)
- [Multiple generic tagging and labeling of output curves using wildcard "*"](#)
- [Multiple curves can be operated upon in one line e.g. "oper ADD acc_* 10.0"](#)
- [Multiple curves can be plotted using wildcards "*" in tag names](#)
- [Integration point output can be changed](#)
- [Multiple models supported](#)
- [Extended plotting syntax for setting up plot defaults \(grid colours, offsets, fonts and so on\)](#)
- ["Tabc" command for writing out tabulation data to a csv file](#)
- ["plot" and "auto" commands added for use in interactive playback mode](#)
- macro support for running FAST-TCF files on specific curves

7.1 FAST-TCF INTRODUCTION

7.1.1 General Rules

1. **Each line** in the input file defines **one** data extraction or plot request
2. Long lines can be split into shorter ones using a continuation character "\" at the end of each line
3. **Space characters** are used to **divide the line into 'words'**
4. The input script is NOT case-sensitive.
5. Unless detailed elsewhere in this manual, the first few (usually three) characters of the first word on the line discriminate the request of a particular entity, and the syntax which applies to reading in the remaining words on the line
6. If the first word on the line is not recognised, the program ignores it - it is treated as a comment
7. The last words on the data extraction request lines allow [options](#) for filtering, Y-axis scaling, HIC, average and a short reference tag (The tags may be used for operation and plotting requests)
8. The last words on the plotting request line allow [options](#) for title, line style and axis changes
9. A successful data extraction always has a curve outputted, if there is no output (e.g. HIC, ERR) then a duplicate curve is outputted. This helps with tagging output curves

7.1.2 Running FAST-TCF

7.1.2.1 Automatic running

FAST-TCF is integrated into the T/HIS executable and can be accessed from the command line or the shell.

Command line syntax:

```
<this executable> -tcf=<FAST-TCF input file> -start_in=<start directory> -exit -batch <thf file name>
```

e.g. this93.exe -tcf=side_impact.tcf -start_in=e:\side_impact\run1 -exit run1.thf

The <thf file file>, -start_in, -exit and -batch syntax are all optional.

NOTES:

- If no THF file is specified then T/HIS will search the directory for the latest one (*.thf).
- If no THF file exists, then T/HIS will look for a d3thdt file (xtf file = xtf file).
- If this does not exist then no thf or xtf input filename is passed to FAST-TCF, and the input file is defaulted to ASCII
- The program runs in any directory you like (via the -start_in command line option). The FAST-TCF output files are created in that directory, and files written out are relative to that directory.

Instead of opening a single model multiple models can be read using the command line option

```
<this executable> -tcf=<FAST-TCF input file> -start_in=<start directory> -exit -batch -model_list=<file name>
```

The -model_list expects a text file with a list of filenames (1 per line) to read into model slots within T/HIS.

e.g. e:\side_impact\run1\run1.thf

e:\side_impact\run2\run2.thf

e:\side_impact\run3\run3.thf

e:\side_impact\run4\run4.thf

Shell operation:

Right click on the SHELLS's T/HIS button, and go to the options menu. Select the FAST-TCF input script and the thf input file if necessary. Return to the main shell menu and press the T/HIS button.

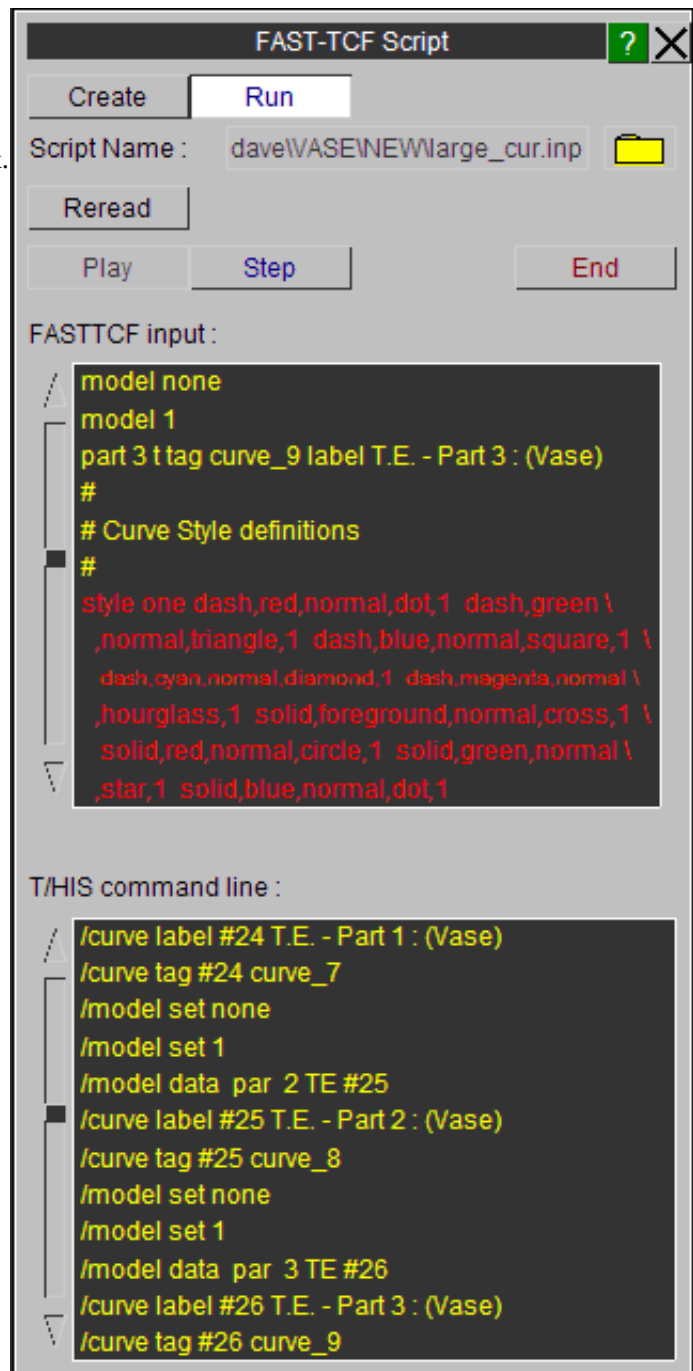
7.1.2.2 Interactive running

In the T/HIS tools menu within T/HIS, select the FAST-TCF option, then click on the "Run" tab in the sub menu that appears. This brings up the following menu:

The user can select the script file then with play the whole file through, or step through each command one by one.

The FAST-TCF line appears in the top dialogue box, and the translated T/HIS line appears in the bottom box. The line about to be sent to T/HIS appears in red text.

To end the script prematurely, hit the "End" button.



7.1.3 Input Files Needed, and Output and Intermediate Files Created

1. **input_script** is **required** at the start.
2. *input_script.output* is a file that contains the concatenated output from FAST-TCF.
3. *input_script.tmp* is a temporary file that FAST-TCF creates for translation. This is merged after completion into *input_script.output* so if you see this file then FAST-TCF didn't finish cleanly.
4. *input_script.rep* is a temporary report file of the FAST-TCF run. This is merged after completion into *input_script.output* so if you see this file then FAST-TCF didn't finish cleanly.
5. *input_script.tcf* are the commands passed to T/HIS from FAST-TCF. This is merged after completion into *input_script.output* so if you see this file then FAST-TCF didn't finish cleanly. The command lines contain special characters such as \r, \m and \l. These are used internally in T/HIS and should be ignored by the user.
6. *input_script.sngval* contains summaries of every curve outputted.

Other files will be made, such as postscript or bitmap plots, but these will have names specified by the user.

7.1.4 Debugging FAST-TCF files

Complicated FAST-TCF files will inevitably go wrong. There are a number of things the user can do to help identify where it is going wrong. Assuming the command line syntax is correct and the correct files are in the run directory, these typical procedures are as follows:

Identifying errors using the interactive playback option in T/HIS:

- Read the model(s) into T/HIS.
- Read the FAST-TCF script into T/HIS under the "FAST-TCF > Run" sub menu.
- Step through the FAST-TCF script manually, keeping an eye on how FAST-TCF is translating the lines, and the output T/HIS is producing.

Identifying if FAST-TCF has found an error:

- If FAST-TCF finds an error, then it is stored and T/HIS then resets the command line and continues to translate the input file. If 10 errors are found then T/HIS will stop at this line. You can set this error amount internally within FAST-TCF.
- Once T/HIS has stopped, the errors are summarised in the command line box and the terminal that T/HIS was run from. The number of warnings found is also printed.
- It should be obvious what is wrong, FAST-TCF checks numerous things, including:
 - Whether T/HIS created the curve from the previous line.
 - That the syntax is correct for all the data input lines (the data extraction requests have additional checking to check the combinations of words inputted is right).
 - If the syntax is correct, whether it applies to the file being requested for output.
 - The output file exists in the directory for the data extraction.
- Correct the input line error utilising the reference tables in this document if applicable.

Identifying what errors T/HIS is giving:

- Identify how many curves were outputted into T/HIS before things went wrong (run T/HIS in graphical mode).
- Place an exit keyword **after the next** input line. This should stop T/HIS just after the line which is causing the file to fail.
- Check what errors T/HIS is giving out. If it's not obvious what went wrong then try another procedure.

Identifying if there are warnings or errors from FAST-TCF:

- The errors are summarised once T/HIS has finished. They are printed in the command line box and the terminal which T/HIS was run from.
- There will be a *input_file.rep* or *input_file.output* file in the directory which contains any warnings or errors that FAST-TCF has detected. Make sure nothing is obviously wrong with the input file using this report file.
- The *input_file.tmp* or *input_file.output* file contains the actual file inputted into FAST-TCF after includes have been found and special characters removed. Check this is correct and all the include files have been accounted for.

Identifying if FAST-TCF is processing the line correctly:

- It's possible that FAST-TCF has processed the line incorrectly. If so, open the *input_file.tcf* or *input_file.output* file to investigate what FAST-TCF is asking T/HIS to do.
- Identify which line is going wrong using the [above procedure](#), and then find this section in the .tcf file. Input the entire tcf request for the line into the T/HIS command box to step through what is being asked from T/HIS. This may highlight where things are going wrong. The command lines contain special characters such as \r, \m and \l. These are used internally in T/HIS and should be ignored by the user.

Using Primer to check a FAST-TCF file:

- Primer has a FAST-TCF check menu under the main check menu. This can be used to check the FAST-TCF

- file data requests against a certain keyword deck.
- Read the deck into Primer, and select MODEL > CHECK > CHECK FAST-TCF FILE. Select the FAST-TCF file and press APPLY. Details can be found in section 3.9 of the Primer manual.
- Primer will highlight any errors that have occurred with the input file with regards to the keyword deck.
- The main Primer checks are if the line syntax is valid, whether the correct file is being outputted, whether the relevant DATABASE_HISTORY is present and whether the id. actually exists.
- Any errors will have to be corrected manually in Primer.

NOTE: If FAST-TCF has completed, then it may be necessary to open the *input_file.output* file which has the all the output files concatenated together in different sections.

7.1.5 Creating FAST-TCF files

The most obvious option is to generate a FAST-TCF script using a text editor such as vim or wordpad. However, an easier option is to use T/HIS as normal, then generate a FAST-TCF script to recreate the curves currently displayed on the screen from within T/HIS.

It involves a single button click to produce a FAST-TCF script that can recreate the plot on the screen.

T/HIS internally stores the history behind each curve; noting which curves, operations and data requests were used to create each curve. This means that the user **does not** have to start recording a command file, and carefully record a script. Instead the user can work for as long as they like as normal, then choose to generate a FAST-TCF script to recreate the plot on the screen by using the FAST-TCF > Create menu.

By default the FAST-TCF script that is generated will contain commands to reproduce all of the graphs that are currently defined in T/HIS. Instead of reproducing all of the graphs the FAST-TCF script can also contain the commands to generate a subset or pages or graphs.

7.1.5.1 FAST-TCF Script : Image Output

This option can be used to add the commands to the FAST-TCF script to generate an image of each graph/page that is selected for output. In addition to selecting the image format a filename can also be specified that is used in the FAST-TCF script as the output filename for images.

7.1.5.2 FAST-TCF Script : Curve Output

This option can be used to add commands to the FAST-TCF script to write curves out to a T/HIS curve file. By default this option will add commands to the FAST-TCF script write any curves that are unblanked in a graph to a curve file. Instead of writing all of the unblanked curves out to a file the "Select Curves" option can be used to select a subset of curves.

7.1.5.3 FAST-TCF Script : Curve Group Output

This option can be used to select additional curves for output to the FAST-TCF script by curve group. If a curve is selected that is also unblanked in one of the graphs the command to regenerate it are only added to the FAST-TCF script once. This option will also add the commands to regenerate the selected curve groups to the FAST-TCF script.

7.2 PAGE / GRAPH LAYOUT AND SELECTION

FAST-TCF scripts can contain commands to create and position multiple graphs. T/HIS Pages can also be created and graphs moved between pages. By default T/HIS will automatically create a single graph on the 1st 'Page' when it starts. If a single graph is required then the script does not need to contain any of the commands in this section. If additional graphs are required then by default they will be created on the 1st Page unless multiple pages have been selected.

Keyword	2nd word	3rd word	4th word	5th word	6th word	7th word	8th word	9th word	notes
Layout	page	wide	-	-	-	-	-	-	Set the page layout to tile wide
		tall	-	-	-	-	-	-	Set the page layout to tile tall
		cascade	-	-	-	-	-	-	Set the page layout to cascade
		1x1	-	-	-	-	-	-	Set the page layout to 1 by 1 graphs per page
		2x2	-	-	-	-	-	-	Set the page layout to 2 by 2 graphs per page
		3x3	-	-	-	-	-	-	Set the page layout to 3 by 3 graphs per page
		XY	m	n	-	-	-	-	Set the page layout to (m) by (n) graphs per page
		custom	-	-	-	-	-	-	Set the page layout to custom
		n	all	-	-	-	-	-	Add all graphs to page (n)
		n	none	-	-	-	-	-	Remove all graphs from page (n)
		n	add	graph	ID	-	-	-	Add graph (ID) to page (n)
		n	remove	graph	ID	-	-	-	Remove graph (ID) from page (n)
		size	m	n	-	-	-	-	Set the page size to m by n pixels
		size	auto	-	-	-	-	-	Set the page size to automatic
	graph	total	n	-	-	-	-	-	Set the total number of graphs to (n)
		create	-	-	-	-	-	-	Create a new graph
		delete	all	-	-	-	-	-	Deletes all graphs except the first one.
		delete	n	-	-	-	-	-	Delete graph (n)
		position	n	x1,y1	x2,y2	-	-	-	Position graph (n) with the bottom left hand corner at screen location (x1,y1) and the top right hand corner at (x2,y2). All coordinates should be in the range 0.0 to 1.0.
		select	all	-	-	-	-	-	Select all graphs
		select	n	-	-	-	-	-	Select graph (n)
		select	none	-	-	-	-	-	Deselect all graphs
		n	axes	position	left	right	top	bottom	Set the position of the left, right, top and bottom axis for graph (n). The positions given should be in the range 0.0 to 1.0 or the word 'Auto'
		n	legend	position	left	right	top	bottom	Set the position of the left, right, top and bottom of the legend for graph (n). The positions given should be in the range 0.0 to 1.0 or the word 'Auto'
		n	legend	format	<type>	-	-	-	Set the legend format to one of <i>default</i> , <i>full</i> , <i>automatic</i> , <i>floating</i> for graph (n)
		n	legend	columns	n	-	-	-	Set the number of columns in the legend to n (1 to 3)
		n	x	format	<type>	-	-	-	Set the x axis unit format to one of <i>automatic</i> , <i>general</i> , <i>scientific</i> for graph (n)
		n	y	format	<type>	-	-	-	Set the y axis unit format to one of <i>automatic</i> , <i>general</i> , <i>scientific</i> for graph (n)
		n	y2	format	<type>	-	-	-	Set the second y axis unit format to one of <i>automatic</i> , <i>general</i> , <i>scientific</i> for graph (n)
		n	x	precision	m	-	-	-	Set the number of decimal places displayed for the x axis values to (m) in graph (n)
		n	y	precision	m	-	-	-	Set the number of decimal places displayed for the y axis values to (m) in graph (n)
		n	y2	precision	m	-	-	-	Set the number of decimal places displayed for the second y axis values to (m) in graph (n)

7.3 INPUT SYNTAX TO LOAD OTHER FILES

FAST-TCF has the option of reading in curve files and other FAST-TCF files nested within the input file. T/HIS now writes out and reads in curve styles and internal tags. FAST-TCF recognizes these tags if the user wishes to refer to them later on in the input file. If they are relative then the include files must be relative to where T/HIS is running from.

Filenames can contain spaces, but if they do then they **must** be enclosed in quotes

e.g. read "c:\my documents\filename.cur".

Description	keyword	second word	notes
Bulk data	readb	bulk data file	curves will be read in at this point in the file, and will be numbered accordingly
CSV 1 (X,Y,X,Y...)	readcsv	csv file	subsequent words can be any of these 2 options:
			lr <row number containing line labels>
			ar <row number containing axis labels>
CSV 2 (X,Y,Y,Y...)	readcsv2	csv file type 2	<nothing - assumes no labels>
			subsequent words can be any of these 3 options:
			xg <x start value> <x interval>
			xc <x values column number>
			Only one of these 2 options can be used
Curve	rea	curve name	lr <row number containing line labels>
			ar <row number containing axis labels>
			<nothing - assumes reading x from column 1 and no labels>
Keyword	readk	keyword file name	curves will be read in at this point in the file, and will be numbered accordingly
FAST-TCF Include	inc	include file name	FAST-TCF will search for includes within includes etc FAST-TCF pastes the include files into the final input file as soon as they are detected

Keyboard entry can also be added into the FAST-TCF file, allowing for simple curves to be created in T/HIS. The keyword for this is **keyboard**. The order of the following words is important, and must be adhered to (see below). The continuation line character is useful here "\".

Keyword	following word	following word	notes
Keyboard	xaxis	x axis name	
	yaxis	y axis name	
	label	curve label	
	data	xval,yval xval2,yval2 xval3, yval3 etc	no space between the x and y values, only a space between the pairs of values

for example, to create an acceleration curve with a straight line at value 1.0:

```
keyboard title straight line \ xaxis time \ yaxis accn \ label straight line at 1.0 \ data 0.000000,1.000000 \
1.000000,1.000000
```

7.4 INPUT FOR DATA EXTRACTION REQUESTS

Each data extraction request occupies one line, with the 'words' on the line separated by space characters.

The line starts with a keyword and the required arguments follow, then any optional requests can occur after the arguments (see later on in the manual).

ID can be a number **or a name** (enclosed in quotes ""), depending on whether the LS-DYNA version supports it in the relevant output file.

Multiple data requests

T/HIS 9.2 onwards supports multiple data output syntax. T/HIS will read the data in one file pass, making it much quicker for larger runs. To use this in FAST-TCF you need to specify the range using a colon (:) and it must be in a single word. As well as the standard numbers you can use, there are some special words namely "all", "first" and "last" (see example).

e.g.	whole_model	te	lsda
	(whole model)	(total energy)	(force lsda file)
	node	42	force y_dir
	(node extraction)	(i.d. 42)	(force in y-direction)
	node	"end of roof"	accel z
	(node extraction)	(i.d. "end of roof")	(z acceleration)
	node	100:last	force y_dir
	(node extraction)	all nodes from 100	(force in y-direction)
	node	all	force y_dir
	(node extraction)	all nodes	(force in y-direction)

7.4.1 Selecting Models

If T/HIS contains more than one model the data extraction commands will attempt to read data from all the model that are currently selected. To specify which model to read data from the following commands can be used

Keyword	second word	notes
model	n	Select model "n" for reading data from
	all	Select all models for reading data from
	none	Unselect all models

7.4.2 Data Extraction options

7.4.2.1 Specifying Files for data extraction

For some LS-DYNA data types results can be extracted from multiple files. By default FAST-TCF scripts will extract data from the default T/HIS file type for each entity type ([see Section 5.17.1](#)). These defaults can be changed via the [preference file](#).

Instead of using the default file any of the valid files types can be specified by using either the [define file](#) keyword (e.g. define file LSDA) or by adding an [extra line option](#). When this occurs, FAST-TCF will take the extraction request from the specified type of file - **but only if T/HIS allows it**.

Keyword	second word	third word	notes
define	file	lsda	will always check that t/his can get the output from this file, if not then the original default file will be chosen (see data extraction table). This file can still be overwritten on the actual input line
		ascii	
		xtf	
		thf	
		default	

e.g. **node 42 displacement x**

(read data from default file)

define file LSDA

node 42 displacement x

(read data from LSDA file)

node 42 displacement x ASCII

(read data from ASCII file)

7.4.2.2 Specifying surfaces and Integration Points

Stress and Strain data components for Shell, Thich Shells and Beams can be extracted for multiple surfaces and integration points. By default FAST-TCF will extract data from the Mid Surface for Shells and Thick Shells and from the 1st integration point for Beams. Instead of using the default surface or integration point the option can be used to select an alternative.

Keyword	second word	third word	fourth word	notes
define	surface	beam	layer number	t = top, m = middle, b = bottom, or use a number for the integration point
		shell		
		thickshell		

e.g. **define surface shell top**

(read data for shell stress/strain values from the top surface)

define surface shell 3

(read data for shell stress/strain values from the 3rd integration point)

define surface thickshell bottom

(read data for thickshell stress/strain values from the bottom surface)

define surface beam #2

(read data for beam stress/strain values from the 2nd integration point)

7.4.3 Defining Groups of Parts

Description	keyword	second word	following words
Group definition	gdef	group id	part ids

The line starts with 'gdef' and is followed by an integer for the group i.d., and then part i.d. numbers separated by spaces, or for a range of parts - separated by a ':':

- No options should be applied to this card, because all the words on the line are written out as integers.
- The input is on one line (which may result in a long line ...).

e.g. **gdef 1 1 2 3 4**
(group define i.d. 1) (parts 1 2 3 and 4)

10:20 30:40
(parts 10000 to 20000 and 30000 to 40000)

7.4.4 Data extraction reference table

Data type	Keyword	Second word	Third word	Fourth word	Description
Airbag	Air	Airbag id	[pr]essure	-	pressure
			[vo]lume	-	volume
			[ie]	-	internal energy
			[in]	-	mass flow rate in
			[ou]	-	mass flow rate out
			[tm]	-	total mass
			[de]nsity	-	Density
			[sa]	-	Surface area
			[te]mp	-	Gas temperature
Airbag Part Data (ABSTAT_CPM)	ab_part	Airbag id	Part id	[pr]essure	pressure
				maf	Mass flow rate through fabric
				mav	Mass flow rate through vent
				ta	Total area
				[un]blocked	Unblocked area
				te]mperature	Temperature
Beam	Bea	Beam id	[n]ormal	x	Axial force
				y	Shear force in Y
				z	Shear force in Z
			[m]oment	y	Moment in Y
				z	Moment in Z
				x	Torsional moment
			[stra]in	-	Axial strain
			[e]nergy	p1	Bending energy: end 1
				p2	Bending energy: end 2
			[r]otation	y1	Y rotation: end 1
				y2	Y rotation: end 2
				z1	Z rotation: end 1
				z2	Z rotation: end 2
				x	Torsional rotation
			[b]ending	y1	Y Bending moment: end 1
				y2	Y Bending moment: end 2
				z1	Z Bending moment: end 1
				z2	Z Bending moment: end 2
			[e]nergy	a	Axial collapse energy
				i	Internal energy
			[stre]ss	x	Axial stress
				xy	XY Shear stress
				zx	ZX Shear stress
			[eff]	-	Effective plastic strain
			[exx]	-	Axial strain

Boundary	Bou	Boundary id	[n]odal loads	fx	Applied X Force
				fy	Applied Y Force
				fz	Applied Z Force
				fm	Applied Resultant force
				e	Energy from applied force
			[ri]gid body loads	fx	Applied X Force
				fy	Applied Y Force
				fz	Applied Z Force
				fm	Applied Resultant force
				e	Energy from applied force
			[p]ressure nodal loads	fx	Applied X Force
				fy	Applied Y Force
				fz	Applied Z Force
				fm	Applied Resultant force
				e	Energy from applied force
			[v]elocity nodal loads	fx	BC motion X Force
				fy	BC motion Y Force
				fz	BC motion Z Force
				fm	Resultant BC motion force
				en	Energy from BC motion
				mx	BC motion X Moment
				my	BC motion Y Moment
				mz	BC motion Z Moment
			[rv]elocity r-body loads	mm	BC Moment Magnitude
				fx	BC motion X Force
				fy	BC motion Y Force
				fz	BC motion Z Force
				fm	Resultant BC motion force
				e	Energy from BC motion
Contact	Con / Sli	Contact id	[f]orce	x	Global X force
				y	Global Y force
				z	Global Z force
				m	Force Magnitude
				xs	Global X force
				ys	Global Y force
				zs	Global Z force
				ms	Force Magnitude
			[e]nergy	t	Total energy
			[g]eometric	fx	X force
				fy	Y force
				fz	Z force
				fm	Force Magnitude
				mx	Moment in X
				my	Moment in Y
				mz	Moment in Z
				mm	Moment Magnitude
Cross section	Cro / Sec	Section id	[f]orce	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
			[m]oment	x	Moment in X
				y	Moment in Y
				z	Moment in Z
				m	Moment Magnitude
			[c]entroid	x	X centroid coord
				y	Y centroid coord
				z	Z centroid coord
			[a]rea	-	Area of section

FSI	FSI	FSI id	[pr]essure	-	pressure
			[f]orce	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
			[po]rous	-	Porous Leakage
Joint	Joi	Joint id	[m]ass	-	Mass Flux
			[f]orce	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
			[m]oment	x	Moment in X
				y	Moment in Y
				z	Moment in Z
				m	Moment Magnitude
			[ph]i	an	Phi angle
				dt	d(Phi)/dt
				st	Phi stiffness moment
				da	Phi damping moment
				to	Phi total moment
			[th]eta	an	Theta angle
				dt	d(Theta)/dt
				st	Theta stiffness moment
				da	Theta damping moment
				to	Theta total moment
			[ps]i	an	Psi angle
				dt	d(Psi)/dt
				st	Psi stiffness moment
				da	Psi damping moment
				to	Psi total moment
			[e]nergy	-	Total joint energy
			[al]pha	an	Alpha angle
				dt	d(Alpha)/dt
				st	Alpha stiffness moment
				da	Alpha damping moment
				to	Alpha total moment
			[be]ta	an	Beta angle
				dt	d(Beta)/dt
				st	Beta stiffness moment
				da	Beta damping moment
				to	Beta total moment
			[ga]mma	an	Gamma angle
				dt	d(Gamma)/dt
				fa	Gamma scale factor
			[to]rsion	e	Total joint energy

Node	No	Node id	[t]emperature		Temperature
			[d]isplacement	x	X Displacement
				y	Y Displacement
				z	Z Displacement
				m	Displacement Magnitude
			[v]elocity	x	X Velocity
				y	Y Velocity
				z	Z Velocity
				m	Velocity Magnitude
			[a]cceleration	x	X Acceleration
				y	Y Acceleration
				z	Z Acceleration
				m	Acceleration Magnitude
			[c]oord	x	Current X coord
				y	Current Y coord
				z	Current Z coord
				m	Current Vector
			[b]asic	x	Basic X coord
				y	Basic Y coord
				z	Basic Z coord
				m	Basic Vector
			[r]otation	x	X rotation
				y	Y rotation
				z	Z rotation
				m	Rotation Magnitude
				vx	X rotational velocity
				vy	Y rotational velocity
				vz	Z rotational velocity
				vm	Rotation Vel Magnitude
				ax	X rotational acceleration
				ay	Y rotational acceleration
				az	Z rotational acceleration
				am	Rotation Accel Magnitude
			force	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
			[e]nergy	-	Energy
Node Group	Ng	Group id	force	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
Part	Pa	Part id	[k]inetic e	-	Kinetic energy
			[i]nternal e	-	Internal energy
			[h]ourglass e	-	Hourglass energy
			[t]otal e	-	Total energy
			[mx]	-	X momentum
			[my]	-	Y momentum
			[mz]	-	Z momentum
			[x] velocity	-	Average X velocity
			[y] velocity	-	Average Y velocity
			[z] velocity	-	Average Z velocity
			[am]	-	Added mass
			[ek]	-	Eroded Kinetic energy
			[ei]	-	Eroded Internal energy
Part group	Gro	Group id	[k]inetic e	-	Kinetic energy
			[i]nternal e	-	Internal energy
			[h]ourglass e	-	Hourglass energy
			[t]otal e	-	Total energy
			[am]	-	Added mass
Retractor	Ret	Retractor id	[fo]rce	-	Force
			[p]ullout	-	Pullout
			[fvp]	-	Force v Pullout

Rigidwall	Rig / Wall	Wall id	[n]ormal force	-	Normal force
			[x] force	-	Global X force
			[y] force	-	Global Y force
			[z] force	-	Global Z force
Rigid part / NRB	rpa / nrb	Part id	[d]isplacement	x	X Displacement
				y	Y Displacement
				z	Z Displacement
				m	Displacement Magnitude
			[v]elocity	x	X Velocity
				y	Y Velocity
				z	Z Velocity
				m	Velocity Magnitude
			[a]cceleration	x	X Acceleration
				y	Y Acceleration
				z	Z Acceleration
				m	Acceleration Magnitude
			[c]oord	x	X coord
				y	Y coord
				z	Z coord
			[r]otation	x	X rotation
				y	Y rotation
				z	Z rotation
				m	Rotation Magnitude
				vx	X rotational velocity
				vy	Y rotational velocity
				vz	Z rotational velocity
				vm	Rotation Vel Magnitude
				ax	X rotational acceleration
				ay	Y rotational acceleration
				az	Z rotational acceleration
				am	Rotation Accel Magnitude
			[dc]os	11	Direction Cosine 11
				12	Direction Cosine 12
				13	Direction Cosine 13
				21	Direction Cosine 21
				22	Direction Cosine 22
				23	Direction Cosine 23
				31	Direction Cosine 31
				32	Direction Cosine 32
				33	Direction Cosine 33
			[ld]isplacement (local)	x	Local X Displacement
				y	Local Y Displacement
				z	Local Z Displacement
			[lv]elocity (local)	x	Local X Velocity
				y	Local Y Velocity
				z	Local Z Velocity
			[la]cceleration (local)	x	Local X Acceleration
				y	Local Y Acceleration
				z	Local Z Acceleration
			[lr]otation (local)	x	Local X rotation
				y	Local Y rotation
				z	Local Z rotation
				vx	Local X rotational vel
				vy	Local Y rotational vel
				vz	Local Z rotational vel
				ax	Local X rotational accel
				ay	Local Y rotational accel
				az	Local Z rotational accel
Seatbelt	Sea / Bel	Belt id	[fo]rce	-	Force
			[s]train	-	Strain
			[fvs]	-	Force v Strain
			[l]ength	-	Current Length

Shell	Sh	Shell id	[stre]ss	xx	Stress in XX
				yy	Stress in YY
				zz	Stress in ZZ
				xy	Stress in XY
				yz	Stress in YZ
				zx	Stress in ZX
				mx	MAX principal stress
				mn	MIN principal stress
				ms	MAX shear stress
				vm	von Mises stress
				av	Average stress (Pressure)
			[stra]in	ef	Effective plastic strain
				xx	Strain in XX
				yy	Strain in YY
				zz	Strain in ZZ
				xy	Strain in XY
				yz	Strain in YZ
				zx	Strain in ZX
				ma	MAX principal strain
				mi	MIN principal strain
				sh	MAX shear strain
				vm	von Mises strain
				av	Average strain
			[m]oment	x	Moment in X
				y	Moment in Y
				xy	Moment in XY
			[f]orce	sx	Shear force in X
				sy	Shear force in Y
				nx	Normal force in X
				ny	Normal force in Y
				nxy	Normal force in XY
			[t]hickness	-	Thickness
			[i]nternal	-	Internal energy density
			[e]xtra	##	Extra data ##
Slipring	Slp	Slipring id	[p]ullout	-	Pull through
Solid	yyp	Solid id	[stre]ss	xx	Stress in XX
				yy	Stress in YY
				zz	Stress in ZZ
				xy	Stress in XY
				yz	Stress in YZ
				zx	Stress in ZX
				mx	MAX principal stress
				mn	MIN principal stress
				ms	MAX shear stress
				vm	von Mises stress
				av	Average stress (Pressure)
			[stra]in	ef	Effective plastic strain
				xx	Strain in XX
				yy	Strain in YY
				zz	Strain in ZZ
				xy	Strain in XY
				yz	Strain in YZ
				zx	Strain in ZX
				ma	MAX principal strain
				mi	MIN principal strain
				sh	MAX shear strain
				vm	von Mises strain
				av	Average strain
			[e]xtra	##	Extra data ##

SPC	SPC	SPC id	[f]orce	x	X force
				y	Y force
				z	Z force
				m	Force Magnitude
			[m]oment	x	Moment in X
				y	Moment in Y
				z	Moment in Z
				m	Moment Magnitude
			[d]ensity	-	Density
				-	Density
SPH	SPH	SPH id	[stra]in	xx	Strain in XX
				yy	Strain in YY
				zz	Strain in ZZ
				xy	Strain in XY
				yz	Strain in YZ
				zx	Strain in ZX
				ef	Effective Stress
				xx	Stress in XX
			[stre]ss	yy	Stress in YY
				zz	Stress in ZZ
				xy	Stress in XY
				yz	Stress in YZ
				zx	Stress in ZX
				-	Smoothing Length
			[l]ength	-	Smoothing Length
Spotweld	Sw	Spotweld id	[co]nstrained	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[ma]ximum	Maximum failure value
				[t]ime	Failure Time
			[ge]neralised	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[ma]ximum	Maximum failure value
				[t]ime	Failure Time
			[sp]otweld	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[ma]ximum	Maximum failure value
				[t]ime	Failure Time
			[so]lid	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[ma]ximum	Maximum failure value
				[t]ime	Failure Time
			[no]n-local	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[ma]ximum	Maximum failure value
				[t]ime	Failure Time
			[ass]embly	[a]xial	Axial force
				[s]hear	Shear force
				[l]ength	Length
				[f]ailure	Failure (failed if > 1.0)
				[m]oment	Resultant Moment
				[t]ime	Failure Time

Spring	Sp / Da	Spring id	[f]orce	-	Force
			[e]longation	-	Elongation
			[fve]	-	Force v Elongation
			[en]ergy	-	Energy
			[m]oment	-	Moment
			[r]otation	-	Rotation
			[mvr]	-	Moment v Rotation
			[x] force	-	Global X force
			[y] force	-	Global Y force
			[z] force	-	Global Z force
			[mx]	-	Moment in X
			[my]	-	Moment in Y
			[mz]	-	Moment in Z
			[re]nergy	-	Rotational Energy
Subsystem	Ss	Subsystem id	[k]inetic e	-	Kinetic energy
			[i]nternal e	-	Internal energy
			[h]ourglass e	-	Hourglass energy
			[kr]	-	Kinetic Energy Ratio
			[ir]	-	Internal Energy Ratio
			[mx]	-	X momentum
			[my]	-	Y momentum
			[mz]	-	Z momentum
Thick Shell	Thi / Tsh	Tshell id	[stre]ss	xx	Stress in XX
				yy	Stress in YY
				zz	Stress in ZZ
				xy	Stress in XY
				yz	Stress in YZ
				zx	Stress in ZX
				mx	MAX principal stress
				mn	MIN principal stress
				ms	MAX shear stress
				vm	von Mises stress
				av	Average stress (Pressure)
			[stra]in	ef	Effective plastic strain
				xx	Strain in XX
				yy	Strain in YY
				zz	Strain in ZZ
				xy	Strain in XY
				yz	Strain in YZ
				zx	Strain in ZX
				ma	MAX principal strain
				mi	MIN principal strain
				sh	MAX shear strain
				vm	von Mises strain
				av	Average strain
			[e]xtra	##	Extra data ##

Whole model	Wh	-	[dt]	-	Time step
			[k]inetic e	-	Kinetic energy
			[i]internal e	-	Internal energy
			[sw]	-	Stonewall energy
			[j]oint e	-	Joint internal energy
			[sp]ring e	-	Spring and damper energy
			[h]ourglass e	-	Hourglass energy
			[sy]stem e	-	System damping energy
			[si]	-	Sliding interface energy
			[ew]	-	External work
			[rb]	-	Rigid Body stopper energy
			[t]otal e	-	Total energy
			[er]	-	Total/initial energy
			[x] velocity	-	Average X velocity
			[y] velocity	-	Average Y velocity
			[z] velocity	-	Average Z velocity
			[cy]cle time	-	Time per zone cycle
			[am]	---	Added mass
			[pm]	-	%age Mass increase
			[ek]	-	Eroded Kinetic energy
			[ei]	-	Eroded Internal energy
			[ewoe]	-	Energy Ratio w/o Eroded
			[m]ass	-	Mass

7.5 UNITS

From version 9.4 onwards T/HIS can automatically add unit information to graph labels and it can convert results from one unit system to another.

Each model in T/HIS can have a Unit System defined for it and a separate Unit System can be defined for displaying results. T/HIS will automatically convert results from the model Unit System to the display Unit System. T/HIS has 6 built in unit systems

Unit System name	Units
U1	m,kg,s
U2	mm,Tonnes,s
U3	mm,kg,ms
U4	mm,gm,ms
U5	ft,slug,s
U6	m,Tonnes,s

7.5.1 Setting the unit system for a model

To set the unit system for a model

Keyword	second word	third word	fourth word	notes
unit	model	n	U1	Set the unit sytem for model 'n' to U1
			U2	Set the unit sytem for model 'n' to U2
			U3	Set the unit sytem for model 'n' to U3
			U4	Set the unit sytem for model 'n' to U4
			U5	Set the unit sytem for model 'n' to U5
			U6	Set the unit sytem for model 'n' to U6
		all	as above	Set the unit system for all models

7.5.2 Setting the DISPLAY unit system

To set the display unit system

Keyword	second word	third word	notes
unit	display	U1	Set the display unit sytem to U1
		U2	Set the display unit sytem to U2
		U3	Set the display unit sytem to U3
		U4	Set the display unit sytem to U4
		U5	Set the display unit sytem to U5
		U6	Set the display unit sytem to U6

7.5.3 Curve Axis units

By default T/HIS will automatically set the Unit System for any curves read from a model to those of the model. In addition to setting the curve Unit System T/HIS will automatically set a unit type for the X and Y axis of the curve. These unit types are maintained through curve operations so that the correct units can be displayed for each curve.

The X and Y Axis units for a curve can be manually set if required.

Keyword	second word	third word	additional words		notes
unit	cx	curve #1	curve #2 to curve #n	Unit ## name	## ends the curve list Set the X axis unit for curves
		*	##	Unit name	## ends the curve list Set the X axis unit for all curves
	cy	curve #1	curve #2 to curve #n	Unit ## name	## ends the curve list Set the Y axis unit for curves
		*	##	Unit name	## ends the curve list Set the Y axis unit for all curves

The Unit name can be any of the following

Time	Rotation	Momentum	Energy Den
Energy	Rot Vel	Density	Mass Flow
Work	Rot Accel	Stress	Frequency
Temperature	Length	Strain	Power
Displacement	Area	Force	Thermal Flux
Velocity	Volume	Moment	Force width
Accel	Mass	Pressure	Moment width

7.5.4 Curve Unit Systems

If a curve has been read in from any source other than a model then the Unit System can also be set.

Keyword	second word	third word	additional words		notes
unit	cu	curve #1	curve #2 to curve #n	Unit System name ##	## ends the curve list Set the Unit System for curves
		*	##	Unit System name	## ends the curve list Set the Unit System for all curves

7.6 CURVE TAGS

In FAST-TCF any operation that uses one or more curves as an input can reference the curve using either the curve number or a curve tag. **The use of curve Tags is strongly recommended as it enables scripts to be easily modified and sections added / deleted without having to renumber all the curve references within the script.**

Curve tags are defined for a curve by adding the keyword TAG to the data extraction command followed by the tag.

e.g.	node	42	force y_dir	tag curve_1
	(node)	(i.d. 42)	(force in y-direction)	(tag the curve as "curve_1")
	node	"end of roof"	accel z	tag point_2
	(node)	(i.d. "end of roof")	(z acceleration)	(tag the curve as "point_2")

If a tag is not specified for a curve then FAST-TCF will automatically generate a tag for the curve using the T/HIS curve number as the TAG.

7.6.1 Tagging curves from a T/HIS curve file

If curves are read in from a T/HIS curve file then the FAST-TCF tag will be generated using the following rules.

1. If the data extraction command contains a TAG option then that TAG will be used.
2. If the curve file contains curve tags then they will be used if the data extraction command DOES NOT contain a TAG option
3. If no tags are specified in the file or in the data extraction command then tag the curves as curve_# where # is the internal T/HIS curve number.

7.6.2 Tagging multiple curve outputs

From version 9.2 onwards multiple curve outputs can be generated from one FAST-TCF input line. Curve tags and labels can be specified for multiple curves using the following special syntax (note this only works on multiple curves):

- If the user specifies a wildcard in the tag or label (a "*"), then FAST-TCF will substitute the wildcard for the number of the curve outputted (starting from 1).
- If the user specifies a "##" then the entity ID is substituted in its place which is useful if the user knows what entities are expected on output.

e.g.	node 5:last	accel mag	tag node_*	lab Head Accn *
	(node IDs. 5 to last)	(accel mag)	tags = node_1, node_2, etc	labels = Head Accn 1, Head Accn 2, etc
	node 10:20	accel mag	tag node_##	lab Head Accn ##
	(nodes 10 to 20)	(accel mag)	tags = node_10, node_11, etc	labels = Head Accn 10, Head Accn 11, etc

7.6.3 Using Wildcards

A number of T/HIS functions and operations can be applied to multiple curves in a single command by specifying multiple curve tags using wildcards.

e.g.	operate	multiple	x_disp_*	10	tag	x_mul_*
	(Multiple all curves with a tag starting with "x_disp_" by 10 and tag the outputs as x_mul_1, x_mul_2 ... - see Section 7.8 for more details)					
	display	x_disp_*				
	(Display all curves with a tag starting with "x_disp_" - see Section 7.11.3 for more details)					
	copy	curve_file.cur	x_disp_*			
	(Write all curves with a tag starting with "x_disp_" to a file called "curve_file.cur"- see Section 7.13 for more details)					

7.7 CURVE GROUPS

Curve groups can be defined within FAST-TCF scripts using the **cgroup** keyword. After a curve group has been defined in a FAST-TCF script it can then be used as an input to some FAST-TCF commands. Each curve group should be given a unique name within the FAST-TCF script.

Keyword	Second word	Third word	following word	notes
cgroup	create	name	-	Create a curve group called "name". If the name contains any spaces then it should be enclosed in quotes ("name with space")
	add	name	curve list	Adds a list of curves to the curve group called "name". If the name contains any spaces then it should be enclosed in quotes ("name with space"). The curve list should be a list of curve tags.
	remove	name	curve list	Removes a list of curves from the curve group called "name". If the name contains any spaces then it should be enclosed in quotes ("name with space"). The curve list should be a list of curve tags.

e.g. cgroup create group_1

(Create a curve group called "group_1")

cgroup add group_1 curve_1 curve_2

(Add curves with tags "curve_1" and "curve_2" to group "group_1")

cgroup create "Group 2"

(Create a curve group called "Group 2")

cgroup add "Group 2" curve_1*

Add all curves with a curve tag containing "curve_1" to group "Group 2"

cgroup remove "Group 2" curve_11

Remove curve with tag "curve_11" from group "Group 2"

To use a curve group as the input to another FAST-TCF command the curve group name is preceeded by an &. If a curve group name contains spaces then the name should be enclosed in double quotes and the & should be before the first ".

e.g. operate multiple &group_1 10 tag output_*

(Multiple all curves in curve group "group_1" by 10 and tag the outputs as output_1, output_2 ...)

operate multiple &"Group 2" 10 tag output_*

(Multiple all curves in curve group "Group 2" by 10 and tag the outputs as output_1, output_2 ...)

Curve Groups can currently be used as

- The first curve input in all of the [operate](#) commands
- Within the list of curves specified as input to [curve range](#) functions.
- To select a group of curves for the [display](#) command.
- Outputting curves to T/HIS curve files and CSV files.

7.8 PERFORMING FAST-TCF CURVE OPERATIONS

Description	keyword	following words
Curve operation	oper	oper command + necessary words (depending on operation)

Many curve processing operations and functions are available. The syntax is common for all types of curve operation:

1. the first word is 'oper' and is followed by:
2. the operation/function name e.g. ADD, int.
3. the required number of arguments for the operation, e.g. ADD requires two arguments, a curve and either a curve or a value.
4. the remainder of the line may contain optional requests.
5. any optional requests can occur after the arguments.
6. curve numbers must be in the format: #<curve number>
7. An output curve is always needed - for operation commands such as hic, hicc, tti, 3ms, err, the curve will be copied and the operation is executed on the copied curve.
8. A curve tag containing a wildcard or a curve group can be specified as the first curve input for any curve operation. If a curve tag contains a wildcard or if a curve group is specified then the curve operation will be repeated for each curve that either the tag matches or is in the curve group.

e.g. oper hic node_acc 1.0 15E-3 label Hic-ed node accn
 (hic) (curve tag) (scale=1.0) (15ms period) (label)

In T/HIS 9.2 onwards, the user can operate on multiple input curves (only the first curve can be multiple at the moment) using the wildcard "*". For example, to multiply all curves starting with the tag **acc**:

e.g. oper mul acc* 9810.0
 (multiply) (on all curves with tag acc*)

7.8.1 Standard operation commands

Description	keyword	operation command	following word #1	following word #2	additional words	notes
Absolute value	oper	abs	curve #1	-	-	
Add Y	oper	add	curve #1	curve #2 or constant	-	
Add X	oper	adx	curve #1	curve #2 or constant	-	
Clip curve	oper	cli	curve #1	x min value / "auto"	x max value / "auto" y min value / "auto" y max value / "auto"	Input requires all 4 values, "auto" sets the value automatically
Combine	oper	com	curve #1	curve #2	-	
Concatenate	oper	cat	curve #1	curve #2	-	
Derivative	oper	dif	curve #1	-	-	
Div Y	oper	div	curve #1	curve #2 or constant	-	
Div X	oper	dix	curve #1	curve #2 or constant	-	
Error calculation	oper	err	curve #1	curve #2	-	Value is stored with the output curve
Integral	oper	int	curve #1	-	-	
Least squares	oper	lsq	curve #1	-	-	
Map	oper	map	curve #1	curve #2	-	
Mul Y	oper	mul	curve #1	curve #2 or constant	-	
Mul X	oper	mux	curve #1	curve #2 or constant	-	
Normalise	oper	nor	curve #1	-	-	
Order	oper	ord	curve #1	-	-	

Reciprocal	oper	rec	curve #1	-	-	
Reverse	oper	rev	curve #1	-	-	
Rolling average	oper	r-av	curve #1	-	-	
Smooth	oper	smo	curve #1	smoothing factor	-	Factor must be an integer
Stress	oper	str	curve #1	"true" or "engineering"	-	
Sub Y	oper	sub	curve #1	curve #2 or constant	-	
Sub X	oper	sux	curve #1	curve #2 or constant	-	
Translate	oper	tra	curve #1	X value	Y value	
Vector 2D	oper	v2d	curve #1	curve #2	-	
Vector mag	oper	vec	curve #1	curve #2	curve #3	
Window	oper	win	curve #1	"han", "cos", "exp"	lead in (only for "cos" option)	Writes out 2 curves
Zero curve	oper	zer	curve #1	-	-	Shifts curve to 0,0

7.8.2 Maths operation commands

Description	keyword	operation command	following word #1	following word #2	additional words	notes
Arc cosine	oper	acos	curve #1	-	-	
Arc sine	oper	asin	curve #1	-	-	
Arc tangent	oper	atan	curve #1	-	-	
Cosine	oper	cos	curve #1	-	-	
Log base 10	oper	log10	curve #1	-	-	
Log base 10 (X)	oper	log10x	curve #1	-	-	
Natural Exp	oper	exp	curve #1	-	-	
Natural log	oper	log	curve #1	-	-	
Natural log (X)	oper	logx	curve #1	-	-	
Power	oper	pow	curve #1	nth power	-	
Sine	oper	sin	curve #1	-	-	
Square root	oper	sqr	curve #1	-	-	
Tangent	oper	tan	curve #1	-	-	

7.8.3 Automotive operation commands

Description	keyword	operation command	following word #1	following word #2	additional words	notes
Delta V	oper	acu	curve #1	offset	time period	
Acceleration severity index	oper	asi	Accn x curve #	Accn y curve #	Accn z curve #	word6 = accn conv factor word7 = x limit word8 = y limit word9 = z limit
Butterworth filter	oper	but	curve #1	cut off freq	order	
C60 filter	oper	c60	curve #1	-	-	
C180 filter	oper	c180	curve #1	-	-	
C600 filter	oper	c600	curve #1	-	-	
C1000 filter	oper	c1000	curve #1	-	-	
Clip value	oper	cva	curve #1	time window	Label displayed on screen (<i>optional</i>)	Value is stored with the output curve
Exceedence	oper	exc	curve #1	auto / pos / neg	-	
Fir filter	oper	fir	curve #1	-	-	
Hic	oper	hic	curve #1	division scale factor	time period	Value is stored with the output curve
Hicd	oper	hicd	curve #1	division scale factor	time period	Value is stored with the output curve

Neck injury criteria	oper	nij	Shear curve #	Axial curve #	Moment curve #	word6 = Fzc tension
						word7 = Fzc compression
						word8 = Myc flexion
						word9 = Myc extension
						word10 = Distance from joint
Regularise	oper	reg	curve #1	new dt value	-	
THIV	oper	thi	Accn x curve #	Accn y curve #	Yaw rate curve #	word6 = Horizontal distance
						word7 = Lateral distance
						word8 = Head to vehicle distance
TTI	oper	tti	Upper rib curve #	Lower rib curve #	Lower spine curve #	Value is stored with the output curve
Viscous criteria ECER95	oper	vc	curve #1	constant A	constant B	ECER95 method
Viscous criteria IIHS	oper	vc2	curve #1	constant A	constant B	IIHS method
Curve Correlation (strict)	oper	corr	strict	curve #1	curve #2	Value is stored with the output curves
Curve Correlation (loose)	oper	corr	loose	curve #1	curve #2	Value is stored with the output curves

7.8.4 Seismic operation commands

Description	keyword	operation command	following word #1	following word #2	additional words	notes
Accn to disp spectra	oper	ad	curve #1	-	-	
Accn to vel spectra	oper	av	curve #1	-	-	
Disp to vel spectra	oper	dv	curve #1	-	-	
Disp to accn spectra	oper	da	curve #1	-	-	
Vel to disp spectra	oper	vd	curve #1	-	-	
Vel to accn spectra	oper	va	curve #1	-	-	
Baseline correction	oper	blc	curve #1	-	-	
Design spectrum	oper	ds	curve #1	broadening factor	-	
FFT	oper	fft	curve #1	-	-	
Non cumulative P.R.	oper	ncp	curve #1	curve #2	-	
Response spectrum	oper	rs	curve #1	damping factor	sampling factor	Sampling must be either 30 or 70

7.8.5 Range of curve operation commands

Description	keyword	operation command	following word #1	following word #2	additional words	notes
Average	oper	ave	curve #1	curve #2 to curve #n	##	"##" ends the curve list
Envelope	oper	env	curve #1	curve #2 to curve #n	##	"##" ends the curve list
Minimum	oper	min	curve #1	curve #2 to curve #n	##	"##" ends the curve list
Maximum	oper	max	curve #1	curve #2 to curve #n	##	"##" ends the curve list
Sum	oper	sum	curve #1	curve #2 to curve #n	##	"##" ends the curve list
Sum	oper	sum	curve #1	curve #2 to curve #n	##	"##" ends the curve list

Extra options can be used after a data component extraction, or a curve operation. After the basic request for a particular component and particular entity have been made, the following extra data on the line is recognised to manipulate the curve further. This includes options to label a curve, scale it, write it out and so on.

e.g.	no 54	accel mag	xsc 1000	ysc 0.0001	hic	lab Head Accn
	(node i.d. 54)	(accel mag)	(scale x and y)		(obtain hic value)	(curve label)
	no 1	accel mag	filter c60		append output.cur	
	(node i.d. 1)	(accel mag)	(filter with C60)		(append the curve to a file)	
	no 1	accel mag	tag node_1_acc			
	(node i.d. 1)	(accel mag)	(tag the curve "node_1_acc" for ease of use later in the script)			

Description	extra option word	following word #1	following word #2	notes
3ms clip	3ms	-	-	Curve is squared and then square rooted to remove -ve values Curve is truncated around 3ms values - only 3ms part is left
Append into file	app	filename	-	Appends into curve file, if it doesn't exist - create it
Combine	com	curve #2	-	Y-value curve #1 vs X-value curve #2
Copy into file	cop	filename	-	Copy will overwrite any previous instance of the file
Error function	err	curve #2	-	
HIC	hic, hic15, hicd	-	-	Curve is squared and then square rooted to remove -ve values, an identical curve is outputted
Filtering	fil	fir	-	
		c60		
		c180		
		c600		
		c1000		
X scale factor	xsc	scale factor	-	
Y scale factor	ysc	scale factor	-	
Label	lab	label word #1	label word #2 etc	Keyword and label must be at the end of the line
Reference tag	tag	tag word	-	Invalid words: "style", "xax", "yax", "title"
ASCII file request	ASC	-	-	
LSDA file request	LSD	-	-	
THF file request	THF	-	-	
XTF file request	XTF	-	-	

From version 9.2 onwards multiple curve outputs can be generated from one FAST-TCF input line. Unfortunately most of the extra options displayed below will NOT work on these multiple outputs. However, support has been added to allow tagging and labeling of all the multiple curves outputted in one go ([see section 7.6.1](#))

7.10 Setting properties for curves

The following options can be used to set up properties for curves.

7.10.1 Setting curve Labels, Titles and tags

Description	keyword	second word	third word	fourth word	notes
Curve Label	lab	curve # or tag	label word 1	label word 2 etc	Specifies a new curve label
Curve Tag	tag	curve # or tag	tag	-	Specifies a new curve tag
Curve Title	tit	curve # or tag	label word 1	label word 2 etc	Specifies a new curve title
Curve X axis label	xla	curve # or tag	label word 1	label word 2 etc	Specifies a new x -axis label
Curve Y axis label	yla	curve # or tag	label word 1	label word 2 etc	Specifies a new y-axis label
1st Y axis	y1	curve # or tag	-	-	puts the curve on the 1st y axis
2nd Y axis	y2	curve # or tag	-	-	puts the curve on the 2nd y axis

From version 9.4 onwards curve properties such as the minimum and maximum values can be displayed in the legend area as well as within the graph area.

The following commands use a new properties keyword and can be used to specify the font, colour and background used to display values as well as selecting which values are displayed on each curve.

Keyword	2nd word	3rd word	4th word	5th word	6th word	7th word	notes
properties	format	font	hm hb cm cb tm tb default	8 10 12 14 18 24 default	standard colour	-	sets up font used to display curve properties fonts available: hm - helvetica medium cb - courier bold tm - times new roman medium etc... font sizes in pt: 8, 10, 12 etc...
		background	standard colour	-	-	-	Set a background colour for the text
		transparency	integer (0-100)	-	-	-	Set the background transparency
		border	standard colour	on/off	-	-	Set a border colour round the text and turn it on/off
		arrow	on/off	-	-	-	Turn on/off a line connecting the text to the min/max value location
		num	y_only	-	-	-	Only display the y value
		num	x_y	-	-	-	Display both the x and y values on a single line
		num	xy	-	-	-	Display both the x and y values on separate lines
		value	<type>	-	-	-	Set the unit format to one of <i>automatic</i> , <i>general</i> , <i>scientific</i> for graph (n)
		precision	m	-	-	-	Set the number of decimal places displayed for the y axis values to (m) in graph (n)
properties	legend	format	off	-	-	-	Turn off the display of curve values in the legend area
			append	-	-	-	Append curve values (min,max,average ...) to the curve labels in the legend.
			2nd	-	-	-	Add a 2nd line to the legend for each curve containing the curve values (min,max,average ...).
		curve #1	curve #2	##	maximum	on/off	Turn on/off the display of one of the following curve properties in the legend. Input one or more curves and terminate the list with ## maximum - display curve maximum value minimum - display curve minimum value average - display curve average value other - display other curve values
					minimum		
					average		
					other		

properties	curves	format	off	-	-	-	Turn off the display of curve values in the graph area
			summary	-	-	-	Display the minimum/maximum value for all of the curves currently visible
			all	-	-	-	Display minimum/maximum values for each curve that is currently visible
		summary	smaximum	on/of	-	-	Turns on/off the display of one of the following curve summary properties smaximum - highlight the maximum value for all the curves displayed sminimum - highlight the minimum value for all the curves displayed lmaximum - label the maximum value for all the curves displayed lminimum - label the minimum value for all the curves displayed
			sminimum				
			lmaximum				
			lminimum				
		curve #1	curve #2	##	smaximum	on/off	Turns on/off the display of one of the following curve summary properties. Input one or more curves and terminate the list with ## smaximum - highlight the maximum value for each curves sminimum - highlight the minimum value for each curves lmaximum - label the maximum value for each curves lminimum - label the minimum value for each curves other - label other curve values
					sminimum		
					lmaximum		
					lminimum		
					other		

The options to generate images can be split into 4 sections: **Curve style definition**, **Plot setup**, **Curve Display** and **Image Generation**:

Description	keyword	second word	following words
Plot style setup	style	style name	style options
Individual curve style	stylec	curve number of tag	style options

The "plot style setup" (keyword style) allows the user to define a plot-specific styling that applies the styles to the curves only when they are requested for a plot. It is independent of the curve id, but dependent on the order the curves are requested in the plot command. The style is given its own "tag" which the user can request on the image FAST-TCF line.

e.g. style ENERGIES solid,green,norm dash,blue,heavy sol,bold,yel,500
(style name) (curve #1) (curve #2) (curve #3)

The "individual curve style" (keyword `stylec`) is the more traditional way of styling a curve that a T/HIS user would be more familiar with - FAST-TCF styles the single curve id instantly. The user can only define one style at a time.

Style options	word options	default
Line style	solid	solid
	dash	
	none	
Line colour	white	dependent on curve #
	red	
	green	
	blue	
	cyan	
	magenta	
	yellow	
	orange	
	turquoise	
	indigo	
	lime	
	sky	
	pink	
	black	
	foreground	
	background	

Line width	fine	normal
	normal	
	bold	
	heavy	
Line symbols	triangle	dependent on curve #
	square	
	diamond	
	hourglass	
	cross	
	circle	
	star	
	dot	
	null	
Symbol frequency	frequency number -	

7.11.2 Plot setup

Description	keyword	following words
Plot setup	setup	plot setup words

These options set the appearance of any plots that are created afterwards. They are to do with the general appearance of the plot rather than the curve itself. The curve appearances can be set up with the [style definition line](#) and on the [image plotting line](#). All following words must be on the same line. If the "on" or "off" is missed out from the following word (where applicable) then FAST-TCF will take the **opposite** to the default (this helps with backwards compatibility issues but can also make a script more compact).

e.g. setup ax bold grid on line bold reverse
 (bold axes) (grid on) (bold lines) (reverse foreground and background)

setup double on border off show 3ms size 250
 (double axes on) (no border) (3ms window on) (size = 1000 x 650 pixels)

setup fonts xl hb 12 yl hb 12 title hb 24
 (font setup) (xlabel & ylabel: helvetica bold 12pt) (title: helvetica bold 24pt)

Plot setup description	plot setup word	following word(s)	notes
Axis thickness	ax	fine normal bold heavy standard colour	for colours - see standard list below
Background	bac	standard colour	for colours - see standard list below
Border	bo	fine normal bold heavy standard colour on or off	for colours - see standard list below
Double yaxis	do	on or off	
Fix line styles	fix	on or off	this overwrites any style definitions
Fonts	fon	[xl]label hm 8 [y]label hb 10 [y2]label cm 12 [xu]nits cb 14 [yu]nits tm 18 [y2u]nits tb 24 [t]title [le]gend [all]	sets up fonts for the image: fonts available: hm - helvetica medium cb - courier bold tm - times new roman medium etc... font sizes in pt: 8, 10, 12 etc...
Foreground	for	standard colour	for colours - see standard list below

Format style	fo	default	
		automatic	
		full	
Grid on	gr	fine	
		normal	
		bold	
		heavy	
		on or off	
Line thickness	li	on	Turn on plotting of curve lines
		off	Turn off plotting of curve lines (symbols drawn)
		fine	set the line thickness to 1 pixel
		normal	set the line thickness to 2 pixels
		bold	set the line thickness to 4 pixels
		heavy	set the line thickness to 8 pixels
Model numbers on labels	mn	auto	"auto" only puts the model number on when there is more than 1 model in T/HIS
		on	
		off	
Reverse black white	re	on or off	
Size of plot	si	integer	xsize = value x 4, ysize = value x 3 (aspect fixed)
Solid x and y axis	so	on or off	
Symbols on	sy	on or off	
X grid controls	xau	-	
	xin	x grid increment	
	xoff	x grid offset	
Y grid controls	yau	-	
	yin	y grid increment	
	yoff	y grid offset	
Axis type, Linear/Logarithmic	xlin	-	Swap the x axis to a linear scale
	xlog	-	Swap the x axis to a logarithmic scale
	ylin	-	Swap the y axis to a linear scale
	ylog	-	Swap the y axis to a logarithmic scale
	y2lin	-	Swap the second y axis to a linear scale
	y2log	-	Swap the second y axis to a logarithmic scale

7.11.2.1 New Plot setup

The following setup commands are new to Version 9.4.

Plot setup description	plot setup word	following word(s)	notes
Graph Title	title	"title string"	Set the title for the graph.
	title_on	-	Turn on the display of the graph title
	title_off	-	Turn off the display of the graph title
X Axis Properties	x_lab	auto	Set the x axis label to be defined automatically
		manual	Set the x axis label to a user defined label
		"label string"	Set the user defined x axis label
		on	Turn on the display of the x axis label
		off	Turn off the display of the x axis label
	x_min	auto	Set the x axis minimum value to automatic
		numerical value	Set the x axis minimum value
	x_max	auto	Set the x axis minimum value to automatic
		numerical value	Set the x axis minimum value
	x_unit	auto	Set the x axis unit label to be defined automatically
		manual	Set the x axis unit label to a user defined label
		"unit string"	Set the user defined x axis label
		on	Turn on the display of the x axis unit label
		off	Turn off the display of the x axis unit label

Y Axis Properties	y_lab	auto	Set the y axis label to be defined automatically
		manual	Set the y axis label to a user defined label
		"label string"	Set the user defined y axis label
		on	Turn on the display of the y axis label
		off	Turn off the display of the y axis label
	y_min	auto	Set the y axis minimum value to automatic
		numerical value	Set the y axis minimum value
	y_max	auto	Set the y axis minimum value to automatic
		numerical value	Set the y axis minimum value
	y_unit	auto	Set the y axis unit label to be defined automatically
		manual	Set the y axis unit label to a user defined label
		"unit string"	Set the user defined y axis label
		on	Turn on the display of the y axis unit label
		off	Turn off the display of the y axis unit label
2nd Y Axis Properties	y2_lab	auto	Set the second y axis label to be defined automatically
		manual	Set the second y axis label to a user defined label
		"label string"	Set the user defined second y axis label
		on	Turn on the display of the second y axis label
		off	Turn off the display of the second y axis label
	y2_min	auto	Set the second y axis minimum value to automatic
		numerical value	Set the second y axis minimum value
	y2_max	auto	Set the second y axis minimum value to automatic
		numerical value	Set the second y axis minimum value
	y2_unit	auto	Set the second y axis unit label to be defined automatically
		manual	Set the second y axis unit label to a user defined label
		"unit string"	Set the user defined second y axis label
		on	Turn on the display of the second y axis unit label
		off	Turn off the display of the second y axis unit label

7.11.2.2 Deprecated Plot Setup Options

The following setup commands are still supported in Version 9.4 but they have been superseded by the new "properties" keyword (see section 7.10)

Plot setup description	plot setup word	following word(s)	notes
Set colour of min/max value	min_max	standard colour	for colours - see standard list below
Show max value	show	max	on off Turn on/off the highlight of the Maximum Value
Show max value	show	min	
Display X value at max	show	xmax	
Display X value at min	show	xmin	
Display Y value at max	show	ymax	
Display Y value at min	show	ymin	
Show 3ms Clip Widow	show	3ms	
Show HIC Widow	show	hic	

7.11.3 Curve Display

The list of curves displayed in each graph is controlled by the **display** keyword. The list of curves can contain a mixture of curve tags, curve numbers (prefixed with #) or curve groups. If curve tags are specified in the curve list then they can contain wildcards.

keyword	second word	notes
display	curve list	The curve list can contain a mixture of curve tags, curve numbers (prefixed with #) or curve groups. If curve tags are specified in the curve list then they can contain wildcards.

The following option can be appended to the **display** keyword after the curve list.

Additional format	format word	following word #1	following word #2	notes
-------------------	-------------	-------------------	-------------------	-------

Style application	sty	style name	-	Curves have styles applied in the order they were defined
--------------------------	-----	------------	---	---

In version 9.4 the the following additional options that can be appended to the **display** keyword after the curve list are still supported although their use is not recommended. Equivalent commands have been added to the [Plot Setup](#) commands along with a number of new options.

Additional format	format word	following word #1	following word #2	notes
Title	tit	title word #1	title word #2 etc	Takes following words as a title until another keyword is found
X axis options	xax	if numeric #1 - xaxis min	if numeric #2 - xaxis max	Takes following words as a label until another keyword is found
		otherwise xaxis label	otherwise xaxis label	
Y axis options	yax	if numeric #1 - yaxis min	if numeric #2 - yaxis max	Takes following words as a label until another keyword is found
		otherwise yaxis label	otherwise yaxis label	
2nd Y axis options	2ya	if numeric #1 - yaxis min	if numeric #2 - yaxis max	Takes following words as a label until another keyword is found
		otherwise yaxis label	otherwise yaxis label	

e.g. **display** **curve_2**
 curve_1

(display "curve_1" and "curve_2")

display **&"Curve group 3"**
 curve_2

**title SLED TEST **
**xax Time **
yax Displacement

(display "curve_2" and all the curves in "Curve group 3". Set the plot title and x and y axis labels.)

7.11.4 Image Generation

Many different types of image format can be outputted from FAST-TCF.

In T/HIS 9.4 onwards the FAST-TCF image output options have been revised to allow multiple graphs and pages to be selected for output. The old pre 9.3 syntax (see Section 7.11.5) is still supported for existing scripts but users are strongly advised to move to the new command format where all options are prefixed with either the "display" or "image" keyword.

Description	keyword	following words
Image output	image	image options

The available image output options are

Option	keyword	format word	second word	third word	fourth word	notes
Bitmap (8 bit)	image	bit / bmp	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Bitmap (8 bit uncompressed)	image	bit_u / bmp_u	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Gif (8 bit)	image	gif	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Png (8 bit)	image	png	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Bitmap (24 bit)	image	bit24 / bmp24	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Pixel map (24 bit)	image	ppm / pix	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Jpeg (24 bit)	image	jpg / jpeg	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Png (24 bit)	image	png24	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
Postscript	image	ps	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'
PDF	image	pdf	filename	graph	all / active / 'n'	Generate an image containing all graphs / all active graphs / graph number 'n'
				page	all / current / 'n'	Generate an image for each page / the current page / page number 'n'

In addition to the image formats the following image output options can also be specified

Description	keyword	second word	notes
Image resolution	i_res	screen / 2x / 4x	Set the resolution to either the same as the screen or 2 or 4 times the screen resolution for image output
Postscript /PDF resolution	p_res	screen / 2x / 4x	Set the resolution to either the same as the screen or 2 or 4 times the screen resolution for Postscript and PDF output
Plot title	ti	title string	Specify the plot title (postscript / PDF output only)
Figure Number	fi	figure number	Specify the figure number (postscript / PDF output only)
Orientation	ori	land / port	Specify the paper orientation (postscript / PDF output only)

image bmp output1.bmp graph all

(generate a bitmap called output1.bmp containing all the current graphs)

image jpeg output2.jpg page 3

(generate a JPEG image called output2.jpg containing page 3)

**image 2x
i_res**

(set the resolution used for all following images to 2 x the screen resolution)

image ti Run number 2

(set the plot title to "Run number 2" for any following postscript or PDF images)

image ori landscape

(set the page layout to landscape for any following postscript or PDF images)

7.11.5 Pre 9.3 Image Output

The following pre T/HIS 9.3 image output commands are still supported but users are recommended to use the new format described above.

Curve styles that have been previously defined can be applied to the curves in the plot, and various other settings can be made with regards to the axes and titles.

Images that require a second yaxis need to determine which curves go on which axis. To do this, use a "##" in the curve listing to switch to the second axis. The options are described in the tables below.

Curve files can be included within the curves to plot. FAST-TCF detects a curve file to read in using the pattern string ".cur" at the end of the name. The curves are read in, styles are applied, and the image is plotted. The curves are then deleted.

The user can use wildcards ("*") in the tag names to select multiple curves for plotting.

bit d.bmp #1 #3 CRV2 ## #2 #4 head_accn Title 2nd axis example
 (2 curves on 1st yaxis and 3 on 2nd yaxis) (Title)

bit h.bmp #1 #3 CRV2 style ONE xax 0 5E-3 Time Title Head
 (curves) (style to apply) (xaxis min and max) (XLabel) (Title)

bit l.bmp #1 #100 reference.cur line.cur #1000 style reference
 (curves and curve files to plot) (style to apply)

bmp test.bmp accn*
 (all curves with tags beginning with "accn")

Description	keyword	second word	following words	following words
Bitmap	bit / bmp	filename	curve(s)	additional formatting
Bitmap (uncompressed)	bit_u / bmp_u	filename	curve(s)	additional formatting
Jpeg	jpg / jpeg	filename	curve(s)	additional formatting
Pixel map	ppm	filename	curve(s)	additional formatting
B & W postscript	post	filename	curve(s)	additional formatting
Colour postscript	cpost	filename	curve(s)	additional formatting

Additional format	format word	following word #1	following word #2	notes
Style application	sty	style name	-	Curves have styles applied in the order they were defined
Title	tit	title word #1	title word #2 etc	Takes following words as a title until another keyword is found
X axis options	xax	if numeric #1 - xaxis min otherwise xaxis label	if numeric #2 - xaxis max otherwise xaxis label	Takes following words as a label until another keyword is found
Y axis options	yax	if numeric #1 - yaxis min otherwise yaxis label	if numeric #2 - yaxis max otherwise yaxis label	Takes following words as a label until another keyword is found
2nd Y axis options	2ya	if numeric #1 - yaxis min otherwise yaxis label	if numeric #2 - yaxis max otherwise yaxis label	Takes following words as a label until another keyword is found

7.12 Outputting curve properties to text files, variables and REPORTER

These requests output a curve property (eg its maximum Y value) into a specified tabulation file, to a REPORTER variable in a text file, or into a variable within FAST-TCF.

Output type	keyword	2nd word	3rd word	4th word	extra words	Format (optional)	variable word	variable name	description words	Notes
Tabulation file	tab	filename	curve #	property to output	if values needed	format	varf	variable name	description	
Tabulation file append	taba	filename	curve #	property to output	if values needed	format	varf	variable name	description	
Tabulation file (csv)	tabc	filename	curve #	property to output	if values needed	format	varf	variable name	description	Each output is appended to the current line in the file.
Tabulation file (csv)	tabcr	filename	curve #	property to output	if values needed	format	varf	variable name	description	Each output is appended to the current line in the file, followed by a carriage return so that the next output starts a new line.
FAST-TCF variable	varf	variable name	curve #	property to output	if values needed	format	-	-	description	
REPORTER variable	var	variable name	curve #	property to output	if values needed	format	varf	variable name	description	
REPORTER variable append	vara	variable name	curve #	property to output	if values needed	format	varf	variable name	description	

7.12.1 Available Curve Properties

Various advanced requests can be performed (e.g. first non-zero Y, maximum in a window) and the table below describes them in more detail. Requests which require inputs (e.g. t1 and t2 of a window) take the default values in the table if the following words do not appear to be numbers, or if no following words exist.

Property to output	property word	value words	notes
Minimum x	minx	-	-
Maximum x	maxx	-	-
Minimum y	min	-	-
X at minimum y	xatmin	-	-
Y at minimum x	yatmin	-	-
Minimum y in window t1 t2	minw	t1 and t2	default t1=-1E19 and t2=+1E19
X at minimum y in window t1 t2	xminw	t1 and t2	default t1=-1E19 and t2=+1E19
Maximum y	max	-	-
X at maximum y	xatmax	-	-
Y at maximum x	yatmax	-	-
Maximum y in window t1 t2	maxw	t1 and t2	default t1=-1E19 and t2=+1E19
X at maximum y in window t1 t2	xmaxw	t1 and t2	default t1=-1E19 and t2=+1E19
Average in window t1 t2	ave	t1 and t2	default t1=-1E19 and t2=+1E19
Hic	hic	-	-
Hicd	hicd	-	-
3ms	3ms	-	-
Y at X	yatx	x value	default xvalue=-1E19
X when Y is passed after gate time	xygate	y value & gate time	default yvalue=-1E19, gate=+1E19
X at first non-zero Y	xnonz	-	nonzero = 1/1000000th of curve max
X at last non-zero Y	xfail	-	nonzero = 1/1000000th of curve max

Y value at last non-zero Y	yfail	-	nonzero = 1/1000000th of curve max
TTI	titi	-	-
Error Function - Max difference & time	max_err	-	-
Error Function - Difference as a %age of reference	pc_err	-	-
Error Function - Difference as a %age of peak reference	pc_max_err	-	-
Error Function - Average Difference	av_err	-	-
Error Function - Average Difference as a %age of peak reference	av_max_err	-	-
Error Function - Area weighted difference	area_err	-	-
Error Function - Max difference & time	err	-	-
Curve Correlation Function	correlate	-	Returns curve correlation value

7.12.2 Writing out curve properties to a text "tabulation" file

This is achieved using the "tabulation" command. This automatically overwrites any existing file in the output directory, but only on the **first occurrence** in the input script. If this is not desired then use the "taba" command which will append an existing file on the first tab call.

A 9.2 onwards option is the "**tabc**" command, which appends the data into csv format on the last line in the file. The first call to this command writes a **new line** to the file, and the subsequent calls append the end of this line. This enables the user to compare runs on a line by line basis in software such as Excel.

Some examples of writing out curve properties to a text file are below:

```
e.g.  tab output.txt #1          max          max y of curve #1
      (file output.txt)  (curve number)  (maximum Y)  (description)
      tab output.txt node_head_accn maxw          1.00E-03 30.00E-3
      (file output.txt)  (curve tag)      (max Y in window) (window t1) (window t2)
      taba output.txt node_head_accn min
      (append output.txt) (curve tag)      (minimum Y)
```

Properties for multiple curves can be output by specifying either multiple "tab" commands or by using a curve tag containing wildcards or a curve group.

```
e.g.  tab output.txt node_*          max          maximum y value
      (file output.txt)  (all curves with a tag starting with node_) (maximum Y)  (description)
      tab output.txt &group_1          max          maximum y value
      (file output.txt)  (all curves in group "group_1")  (maximum Y)  (description)
```

7.12.3 Writing out REPORTER variables

REPORTER can write curve properties to its reports, so FAST-TCF needs to output a text file that REPORTER can interrogate to find out the curve properties it needs. To tell FAST-TCF to output a REPORTER variable, the keyword "varr" is used (for backwards compatibility "var" is sufficient). Use "vara" to append to an existing file.

```
e.g.  varr head_hic          #1          hic          hic result for head node
      (REPORTER variable %head_hic%) (curve number 1) (output request) (description)
e.g.  vara max_y          #1          max          maximum y value
      (REPORTER variable %max_y%)  (curve number 1) (output request) (description)
```

7.12.4 Setting up new FAST-TCF variables to contain curve properties

If you wish to use a curve property as a new variable within FAST-TCF - there are two ways you can achieve this.

1. Use the keyword "varf". This should be used when the user doesn't also require the value to be outputted into a text file or a REPORTER file.

2. Within a **"tab"**, **"taba"**, **"tabc"** or **"varr"** line, use the word "varf" just **before** the description words. The variable name is defined as the word after "varf".

The variable value is equal to the return value of the request. The variable can then be used in any subsequent lines of FAST-TCF.

For instance, the simplest way to set the variable **MAX_ACCN** to the max of curve #1 is:

```
varf MAX_ACCN #1 max
```

However, if the user wishes to combine writing a property to a text file and defining a variable in FAST-TCF, this syntax could be used:

```
tab output.txt #1 max varf MAX_ACCN
```

7.12.5 Format

From Version 9.3 onwards the format used to display the value can be controlled by adding an optional "format" keyword after the property to be output and any additional inputs that property requires. The format should be specified directly after the "format" keyword and should use standard "C" programming syntax to specify a floating point format using either f,e,E,g or G format specifiers.

```
e.g. tab output.txt head max max y of curve #1
      (file output.txt) (curve tag) (maximum Y) (description)
tab output.txt head max format %6.3f max y of curve #1
      (file output.txt) (curve tag) (maximum Y) (format) (description)
tab output.txt head max format %.3f max y of curve #1
      (file output.txt) (curve tag) (maximum Y) (format) (description)
```

Example formats

Number	Format	Output
12.3456	%5.2f	12.35
12.3456	%7.3e	1.2345e+01
12.3456	%7.3E	1.2345E+01
2345678.9	%.0f	2345678
2345678.9	%6.4g	2.3457e+06
2345678.9	%6.4G	2.3457E+06
-0.000013583	%4.3e	-1.358E-05

7.12.6 Description

From Version 9.3 onwards the description specified as part of the output for a curve property can contain the following keywords that will automatically be replaced with the corresponding curve property.

keyword	Curve Property
{tag}	FAST-TCF curve tag
{label}	Curve label
{id}	Entity ID that the curve was created from
{Model}	Model ID curve was created from

```
e.g. tab output.txt head max Max accl of node {id}
      (file output.txt) (curve tag) (maximum Y) (description)
tab output.txt head max Model {model} max accl of node {id}
      (file output.txt) (curve tag) (maximum Y) (description)
```

7.13 FAST-TCF CURVE OUTPUT

Curves can be written out to either T/HIS curve files or CSV files from within a FAST-TCF script by using either the "app", "cop", "csv" or "csv2" keyword.

Description	keyword	second word	third word		notes
Copy into file	cop	filename	curve list	-	will overwrite any previous file
Append into file	app	filename	curve list	-	will append any previous file
CSV file TYPE 1	csv	filename	curve list	-	will overwrite any previous csv file. CSV has the format X1,Y1,X2,Y2,X3,Y3
CSV file TYPE 2	csv2	filename	curve list	last word = auto	will overwrite any previous csv file. CSV has the format X1,Y1,Y2,Y3 x axis interval is taken from curve #1 if all curves are chosen
				2nd last word= x start time last word = x axis interval	will overwrite any previous csv file. CSV has the format X1,Y1,Y2,Y3 start time and interval are defined in the line

The curve list for all of these commands can contain either curve tags (with or without wildcards), curve numbers (prefixed with #), curve groups or '*' to select all curves.

e.g. copy output_file.cur curve_1 &"group 1"

(Write "curve_1" and all the curves in curve group "group 1" to a new file "output_file.cur")

append output_file.cur curve_1 &"group 1"

(Append "curve_1" and all the curves in curve group "group 1" to the file "output_file.cur")

csv output.csv curve_1* curve_2*

(Write all curves with tags that start with "curve_1" or "curve_2" to a CSV called "output.csv")

NOTE : There is no limit to the number of curves that can be output to a file but there is a limit to the number of items that can be specified in the curve list (currently 100). If more than 100 curves are to be output to a file then a [curve group](#) containing all of the curves should be created and used within the curve list. Alternatively if the curves are being written to a T/HIS curve file then the first 100 curves can be output using the "cop" keyword and then additional curves can be appended to the file using the "app" keyword.

7.14 FAST-TCF ADDITIONAL

7.14.1 T/HIS preferences and additional commands

There are a number of additional commands that improve the functionality of FAST-TCF such as labeling, resetting values, tagging curves and defining variables. All following words must be on the same line. The variables section is explained in more detail [below](#).

e.g.	report 3ms	err	hic
	(FAST-TCF.clp written to)	(FAST-TCF.err written to)	(FAST-TCF.hic written to)
	define file	lsda	
		(define lsda as default file)	
	copy output.cur	#1	
	(file name)	(copy curve #1 into file name)	
	define var	date	30_Nov_2005
	(define variable)	(variable name)	(variable value)

Description	keyword	second word	third word	fourth word	notes
Autoscale plot	ac	-	-	-	for use in interactive playback
Auto update plot	auto	on or off	-	-	whether to auto update the plot on data read / font updates and so on. Please note this is reset to ON after any font definition.
Plot graphs	plot	-	-	-	for use in interactive playback
Append into file	app	filename	curve name	-	will append any previous file
Define FAST-TCF variable	def	var	name (without "\$")	value	see FAST-TCF variables section
Define error fail value	def	err	error value (integer)	-	default is 10 errors before T/HIS will stop
Define default file	def	file	lsda	-	will always check that t/his can get the output from this file, if not then the original default file will be chosen (see data extraction table). This file can still be overwritten on the actual input line
			ascii		
			xtf		
			thf		
			default		
Define default title	def	tit	title word 1	title word 2 etc	
Define user line	def	user	user line number (1 to 6)	font size (8 to 24)	rest of line is the label
Define surface integration	def	surf	shell / beam / thickshell	layer number	t = top, m = middle, b = bottom, or use a number for the integration point
Exit reading file	exit	-	-	-	stops reading file here
Model set	mod	model # or "no" or "all"	-	-	sets the model number for extracting curve data
Regularise filtering	reg	time interval, or "off"	-	-	sets the auto regularise interval and turns it on, or turns it off
Report files written	rep	3ms	-	-	To turn off see the reset2 keyword
		asi			
		err			
		hic			
		thiv			
		tti			
Reset	reset1	-	-	-	All curves and curve tags deleted
	reset2	-	-	-	Plot setup defaulted and all style definitions removed. Report files not written
	reset3	-	-	-	Variable names and default title removed

7.14.2 Limits

Description	limit
word limit per line	80 words
include file name	150 characters
tag length	60 characters

7.14.3 Variables

Variable names can only have "a-z", "0-9" and "_" in them. Variables can be inserted anywhere in the script, FAST-TCF will replace any variables with their corresponding values before processing the line, for example:

```
define var output displacement
define var nod_id 12345678
define var xscale 0.001

node $nod_id $output x xscale $xscale
```

converts into:

```
node 12345678 displacement x xscale 0.001
```

Variable definitions can contain several words or other variables, and these will be joined together to form the final variable value, for example:

```
define var day 31st
define var month january
define var year 2099
define var date $day _ $month _ $year
```

creates the variable **date** with value **31st_january_2099**

Because variables cannot have anything other than "a-z", "0-9" and "_" in them, it is possible to use variables within strings:

```
define var analysis run01_vers2

read january_$analysis.cur
```

converts into

```
read january_run01_vers2.cur
```

However, sometimes the user may want to insert a variable within other alphanumeric words, in these circumstances use a "\$\$" terminator to designate the end of the variable name:

```
define var analysis xyz_run01
read $analysis$$_x.cur
```

converts into

```
read xyz_run01_x.cur
```

There are several built in variables, and these depend on the system and command line used to run FAST-TCF, they can be checked on the dialogue T/HIS prints before starting:

- The built-in variable **\$run_name** is the basename of the key file in for the 1st model directory (should there be one). If a script refers to multiple models then **\$run_nameN** (where **N** is the model number) can be used for each model.
- The built-in variable **\$run_title** is the title of the analysis found in the output files. If a script refers to multiple models then **\$run_titleN** (where **N** is the model number) can be used for each model.
- The built-in variable **\$run_dir** is the full pathname of the directory containing the output files for a model. If a script refers to multiple models then **\$run_dirN** (where **N** is the model number) can be used for each model.
- The built-in variable **\$ftcf_dir** is the name of the directory the script is running in.
- The built-in variable **\$ftcf_path** is the full pathname of the directory the script is running in.

7.14.4 Notes and Presumptions

- Curves must be in the format: #<curve number> to differentiate between curves and constants
- Any image will be overwritten if it already exists in the run area
- Curves are always labeled and then written to files, any other options are done in the order of input on the line
- If your line is getting too long, use a "\" to designate a continuation line - FAST-TCF will then join the lines together before processing

APPENDICES

[A LS-DYNA Data Components](#)

[B Format of a T/HIS Curve File](#)

[C Format of a T/HIS Bulk Data File](#)

[D Filtering](#)

[E Injury Criteria](#)

[F Curve Correlation](#)

[G The ERROR function](#)

[H The "preference" file](#)

[I Command line options and Windows file associations](#)

[J List of Typed Commands](#)

APPENDIX A - LS-DYNA Data Components

A.1 Model Data Components

The following global data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
DT	Time Step	yes		yes	yes
KE	Kinetic energy	yes		yes	yes
IE	Internal energy	yes		yes	yes
SWE	Stonewall energy			yes	yes
SPE	Spring and damper energy			yes	yes
HG	Hourglass energy	yes		yes	yes
SDE	System damping energy			yes	yes
JE	Joint internal energy			yes	yes
SIE	Sliding interface energy			yes	yes
EW	External work		yes	yes	yes
RBE	Rigid Body stopper energy			yes	
TE	Total energy	yes		yes	yes
TER	Total/initial energy ratio			yes	yes
VX	Average X velocity	yes		yes	yes
VY	Average Y velocity	yes		yes	yes
VZ	Average Z velocity	yes		yes	yes
TZC	Time per zone cycle			yes	yes
AM	Added mass			yes	yes
PM	%age Mass increase			yes	yes
EKE	Eroded Kinetic energy			yes	yes
EIE	Eroded Internal energy			yes	yes
ER	Energy Ratio w/o Eroded			yes	yes
DRCE	Current Distortional Kinetic Energy				yes
DRMX	Maximum Distortional Kinetic Energy				yes
DRCO	Convergence Factor				yes
DRKE	Total Kinetic Energy				yes

A.2 Part Data Components

For Parts the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
KE	Kinetic energy	yes		yes	yes
IE	Internal energy	yes		yes	yes
HG	Hourglass energy	yes		yes	yes
TE	Total energy	yes		yes	yes
XM	X momentum			yes	yes

YM	Y momentum			yes	yes
ZM	Z momentum			yes	yes
VX	Average X velocity	yes		yes	yes
VY	Average Y velocity	yes		yes	yes
VZ	Average Z velocity	yes		yes	yes
MA	Mass	yes		yes	yes
EIE	Eroded Internal energy			yes	yes
ER	Energy Ratio w/o Eroded			yes	yes

A.3 Part Group Data Components

For Part Groups the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
KE	Kinetic energy	yes		yes	yes
IE	Internal energy	yes		yes	yes
HG	Hourglass energy	yes		yes	yes
TE	Total energy	yes		yes	yes
MA	Mass	yes		yes	yes

A.4 Nodal Data Components

For nodes the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
TE	Temperature	yes			yes
DX	X Displacement	yes		yes	yes
DY	Y Displacement	yes		yes	yes
DZ	Z Displacement	yes		yes	yes
DM	Displacement Magnitude	yes		yes	yes
VX	X Velocity	yes		yes	yes
VY	Y Velocity	yes		yes	yes
VZ	Z Velocity	yes		yes	yes
VM	Velocity Magnitude	yes		yes	yes
AX	X Acceleration	yes		yes	yes
AY	Y Acceleration	yes		yes	yes
AZ	Z Acceleration	yes		yes	yes
AM	Acceleration Magnitude	yes		yes	yes
CX	X Co-ordinate			yes	yes
CY	Y Co-ordinate			yes	yes
CZ	Z Co-ordinate			yes	yes
RX	X Rotation			yes	yes
RY	Y Rotation			yes	yes
RZ	Z Rotation			yes	yes
RM	Rotation Magnitude			yes	yes
RVX	X Rotational Velocity			yes	yes

RVY	Y Rotational Velocity			yes	yes
RVZ	Z Rotational Velocity			yes	yes
RVM	Rotational Velocity Magnitude			yes	yes
RAX	X Rotational Acceleration			yes	yes
RAY	Y Rotational Acceleration			yes	yes
RAZ	Z Rotational Acceleration			yes	yes
RAM	Rotational Acceleration Magnitude			yes	yes
FLX	X Thermal Flux				yes
FLY	Y Thermal Flux				yes
FLZ	Z Thermal Flux				yes
FLM	Thermal Flux Magnitude				yes

The desired node, or range of nodes, and data component are selected by pressing the buttons for the available items in the selection window.

Only nodes that have been declared in "nodal time-history blocks" will be available for processing. To get a list of available node numbers in command line mode use the **M(enu)** command.

Coordinate system of results

All nodal results are in the global cartesian coordinate system **except** at nodes which have been defined as accelerometers: these report accelerations in the local coordinate system of the accelerometer subject to any rotations its "parent" rigid body has undergone.

In command line mode the read nodal data command is used as follows:

/RE NO nn <component> #curve

where **nn** is the node number

<component> is the data component from the list above

curve is the target curve number

A.5 Solid Data Components

For solids the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
Stress components					
SXX	Stress in XX	yes		yes	
SYX	Stress in YX	yes		yes	
SYY	Stress in YY	yes		yes	
SZY	Stress in YZ	yes		yes	
SZZ	Stress in ZZ	yes		yes	
SZX	Stress in ZX	yes		yes	
SXY	Stress in XY	yes		yes	
SMX	Maximum Principal Stress	yes		yes	
SMN	Minimum Principal Stress	yes		yes	
SMS	Maximum Shear Stress	yes		yes	
SVM	Von Mises Stress	yes		yes	
SAV	Average Stress (Pressure)	yes		yes	
Strain components					
EFF	Effective Plastic Strain	yes		yes	

EXX	Strain in XX	yes		yes	
EYY	Strain in YY	yes		yes	
EZZ	Strain in ZZ	yes		yes	
EXY	Strain in XY	yes		yes	
EYZ	Strain in YZ	yes		yes	
EZX	Strain in ZX	yes		yes	
EMX	Maximum Principal Strain	yes		yes	
EMN	Minimum Principal Strain	yes		yes	
EMS	Maximum Shear Strain	yes		yes	
EVM	Von Mises Strain	yes		yes	
EAV	Average Strain	yes		yes	
"Extra" components					
SOEn	Extra Data Component	yes			

Only solids that have been declared in "solid element time-history blocks" will be available for processing. To get a list of available element numbers in command line mode use the **M(enu)** command.

Coordinate systems of results

The stress and strain tensors are reported in the global cartesian system unless the option to output results in the part coordinate system has been used. Writing the directional strain tensor is optional in LS-DYNA: it will only appear in the menu if it is present.

"Extra" data components

The "extra" data components (**SOEn**) are also optional and only appear if present in the database. They are material dependent results, and are treated as scalar data of unknown type by T/HIS.

In command line mode the read solid element data command is used as follows:

/RE S0 nn <component> #curve

where **nn** is the solid element number

<component> is the data component from the list above

curve is the target curve number

A.6 Beam Data Components

For beams the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
Basic data components					
NX	Axial force	yes		yes	
NY	Shear force in Y	yes		yes	
NZ	Shear force in Z	yes		yes	
MY	Moment in Y	yes		yes	
MZ	Moment in Z	yes		yes	
MX	Torsional moment	yes		yes	
"Plastic" data components					
EAX	Axial strain	yes			
PE1	Plastic Bending energy : end 1	yes			

PE2	Plastic Bending energy : end 2	yes			
RY1	Y rotation : end 1	yes			
RY2	Y rotation : end 2	yes			
RZ1	Z rotation : end 1	yes			
RZ2	Z rotation : end 2	yes			
RX	Torsional rotation	yes			
MY1	Y Bending moment : end 1	yes			
MY2	Y Bending moment : end 2	yes			
MZ1	Z Bending moment : end 1	yes			
MZ2	Z Bending moment : end 2	yes			
ACE	Axial collapse energy	yes			
IE	Internal energy	yes			
Integration Point Data					
SXX	Axial stress	yes		yes	
SXY	XY Shear stress	yes		yes	
SZX	ZX Shear stress	yes		yes	
EFF	Effective plastic strain	yes			
EXX	Axial strain	yes		yes	

Additional Beam Results: written if requested from LS-DYNA

In addition to the basic data components additional beam results may be output to the **.THF** file for both Belytschko-Schwer and Hughes-Liu beam elements. As no indication of the element type is written to the **.THF** file it is impossible for T/HIS to work out whether a specific element is a Belytschko-Schwer or a Hughes-Liu beam. As the element type is unknown the user must know which element type a beam is in order to extract the correct results.

Belytschko-Schwer Beams

If you have used Belytschko-Schwer beams with a resultant plastic material model the following "plastic" results will also be written out to **.THF** file: (Note that these data are written even if the ***DATABASE_EXTENT_BINARY** card field **<beamip>** is not set - the presence of a resultant beam material triggers their output automatically. This is not the case for Hughes-Liu data components, for which output must be requested explicitly, see below.)

Where "extra" results are written, and T/HIS cannot resolve unambiguously whether they are Belytschko-Schwer plastic data, or Hughes-Liu stress/strain data, **it is your responsibility to interpret the results correctly.**

Beam results are always output in the element local coordinate system. Only beams declared in "beam element time-history blocks" will be available.

In command line mode the read beam element data command is used as follows:

/RE BE nn <component> #curve

where **nn** is the beam element number

<component> is the data component from the list above

curve is the target curve number

A.7 Shell Data Components

For shells the following data components are available. These combine with directions for the data component, and in some cases a location through the shell thickness.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
--	-----------	--------------	--------------	---------------	-------

Stress components					
SXX	Stress in XX	yes		yes	
SYX	Stress in YY	yes		yes	
SZZ	Stress in ZZ	yes		yes	
SXY	Stress in XY	yes		yes	
SYZ	Stress in YZ	yes		yes	
SZX	Stress in ZX	yes		yes	
SMX	Maximum Principal Stress	yes		yes	
SMN	Minimum Principal Stress	yes		yes	
SMS	Maximum Shear Stress	yes		yes	
SVM	Von Mises Stress	yes		yes	
SAV	Average Stress (Pressure)	yes		yes	
Strain components					
EFF	Effective Plastic Strain	yes		yes	
EXX	Strain in XX	yes		yes	
EYY	Strain in YY	yes		yes	
EZZ	Strain in ZZ	yes		yes	
EXY	Strain in XY	yes		yes	
EYZ	Strain in YZ	yes		yes	
EZX	Strain in ZX	yes		yes	
EMX	Maximum Principal Strain	yes		yes	
EMN	Minimum Principal Strain	yes		yes	
EMS	Maximum Shear Strain	yes		yes	
EVM	Von Mises Strain	yes		yes	
EAV	Average Strain	yes		yes	
Force / Moment components					
MX	Moment in X	yes			
MY	Moment in Y	yes			
MXY	Moment in XY	yes			
QX	Shear force in X	yes			
QY	Shear force in Y	yes			
NX	Normal force in X	yes			
NY	Normal force in Y	yes			
NXY	Normal force in XY	yes			
Miscellaneous components					
T	Thickness	yes			
I	Internal energy density	yes			
"Extra" components					
An	Extra Data Component	yes			

Stress & strain tensors are in the global cartesian system unless the option to use material axes has been invoked for orthotropic materials. Results are available at top and bottom integration points and mid-surface. The strain tensor is optional.

Force and moment resultants are <data> per unit width, and are written in the element local axis system. Refer to "Theory of Plates and Shells", Timoshenko, for a precise definition of these values.

The "additional" data components will only appear in the menu if they have been selected for output.

Shell "surface" selection

Having selected a shell component a prompt is then given for the shell "surface" if relevant for that component. Options are:

- T** Top integration point or <#**layer id**> (see below)
- C** Centre (neutral axis)
- B** Bottom integration point

Note that the top and bottom "surfaces" are **not** the outer fibres, but rather the outer and inner integration points. The relationship between integration point location and shell thickness depends on the number of integration points used.

The following diagram shows locations of integration points with respect to shell half-thickness (**t/2**) assuming the default Gaussian integration rules have been used:

No of Points	Distance from neutral axis as a proportion of t/2
1	0.0 (membrane) ----- Top fibre
2	0.577 t/2
3	0.775 ----- Neutral axis
4	0.861 t/2
5	0.906 ----- Bottom fibre

The "top" (or outer) point is on the positive local Z side of the element neutral axis. The output of shell data from LS-DYNA will fall into one of two categories, and the "surface" options available in T/HIS depend on this.

Note also that it is possible to use non-default integration schemes in LS-DYNA which may locate the integration points at different places. This is an advanced topic: contact Oasys Ltd for advice.

Default output case: 3 "surfaces"

In this case, regardless of how many integration points the shell elements may actually have through their thickness, LS-DYNA writes out:

- Top surface : Outer (top) integration point
- Centre surface : Computed neutral axis value
- Bottom surface : Inner (bottom) integration point

Note that the "centre" surface here is the neutral axis value. For membrane elements all three sets of values will be the same.

These three "surfaces" may be selected by the **T**(op), **C**(entre) and **B**(ottom) surface options.

Optional output case: user-defined number of integration points

In this case the number of integration points defined will be written to the database file, and this dictates the output for all shells, regardless of how many integration points they may have through their thickness. Thus LS-DYNA writes out:

- Layer n : Nth (top) integration point
- : :
- Layer 2 : Second integration point
- Layer 1 : First (bottom) integration point

Note that no explicit neutral axis value is calculated or output, and the outcome of writing more integration points than have been used in a shell formulation is undefined.

Each explicit "layer" may be selected by giving its number when prompted for a "surface". Alternatively the "top", "centre" and "bottom" surface names may be used as before, and the logic used inside T/HIS to interpret these is:

Top surface : Is the highest layer

Centre surface : Is the middle layer if the number of layers is an odd number, or the average of the two middle layers the number of layers is even

Bottom surface : Is layer number one

Note that there is no guarantee that the "centre" surface in this context is the neutral axis value: this will depend upon the element integration scheme. In addition where the "centre" value has been averaged from a pair of points, when the number of layers is an even number, it will definitely not be the neutral axis value: consider plastic strain in a section in pure bending!

It is recommended that non-default output only be used for composites, or in cases where the detailed distribution of data through the element thickness is needed.

In command line mode the read shell element data command is used as follows:

/RE SH nn <component> <surface> #curve

where **nn** is the beam element number

<component> is the data component from the lists above

<surface> is the shell "surface"

curve is the target curve number

A.8 Thick Shell Data Components

For thick shells the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
Stress components					
SXX	Stress in XX	yes		yes	
SYX	Stress in YY	yes		yes	
SZZ	Stress in ZZ	yes		yes	
SXY	Stress in XY	yes		yes	
SYZ	Stress in YZ	yes		yes	
SZX	Stress in ZX	yes		yes	
SMX	Maximum Principal Stress	yes		yes	
SMN	Minimum Principal Stress	yes		yes	
SMS	Maximum Shear Stress	yes		yes	
SVM	Von Mises Stress	yes		yes	
SAV	Average Stress (Pressure)	yes		yes	
Strain components					
EFF	Effective Plastic Strain	yes		yes	
EXX	Strain in XX	yes		yes	
EYY	Strain in YY	yes		yes	
EZZ	Strain in ZZ	yes		yes	
EXY	Strain in XY	yes		yes	
EYZ	Strain in YZ	yes		yes	
EZX	Strain in ZX	yes		yes	

EMX	Maximum Principal Strain	yes		yes	
EMN	Minimum Principal Strain	yes		yes	
EMS	Maximum Shear Strain	yes		yes	
EVM	Von Mises Strain	yes		yes	
EAV	Average Strain	yes		yes	
"Extra" components					
An	Extra Data Component	yes			

Having selected a thick shell component you a prompt is given for the shell "surface" as follows:

T Top integration point or <Layer id>

C Centre (neutral axis)

B Bottom integration point

"Surfaces" and layer numbers for thick shells are treated in exactly the same way as for thin shells as described above.

Stress and strain tensor results for thick shells are always in the global cartesian system unless the option to use the material system (for orthotropic materials) has been used.

The strain tensor for thick shells is optional.

Results will only be available for thick shells declared in "thick shell time-history blocks".

In command line mode the read shell element data command is used as follows:

/RE TS nn <component> <surface> **#curve**

where **nn** is the beam element number

 <component> is the data component from the lists above

 <surface> is the thick shell "surface"

curve is the target curve number

A.9 Rigid Wall Data Components

For rigid walls the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FN	Normal force		yes	yes	yes
FX	Global X force			yes	yes
FY	Global Y force			yes	yes
FZ	Global Z force			yes	yes

A.10 Descrete Element (Sping/Damper) Data Components

For springs and dampers the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FT	Force		yes	yes	yes
ET	Elongation		yes	yes	yes
FE	Force versus Elongation		yes		
EN	Energy		yes		

MT	Moment		yes	yes	yes
RT	Rotation		yes	yes	yes
MR	Moment versus Rotation		yes		
FX	Global X force			yes	yes
FY	Global Y force			yes	yes
FZ	Global Z force			yes	yes
MX	Moment in X			yes	yes
MY	Moment in Y			yes	yes
MZ	Moment in Z			yes	yes

A.11 Seat Belt Data Components

For seat belts the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FT	Force		yes	yes	yes
ST	Strain		yes		
FS	Force versus Strain		yes		
CL	Current Length			yes	yes

A.12 Retractor Data Components

For retractors the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FT	Force		yes	yes	yes
PT	Pullout		yes	yes	yes
FP	Force versus Pullout		yes		

A.13 Slipping Data Components

For slippings the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
PT	Pull through		yes	yes	yes

A.14 Contact Data Components

For contacts the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	Global X force		yes	yes	yes
FY	Global Y force		yes	yes	yes
FZ	Global Z force		yes	yes	yes
FM	Force Magnitude		yes	yes	yes

TEN	Total energy				yes
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A.15 Nodal Reaction Force Data Components

For nodal reactions the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	X Force		yes	yes	yes
FY	Y Force		yes	yes	yes
FZ	Z Force		yes	yes	yes
FM	Force Magnitude		yes	yes	yes
EN	Energy			yes	yes
LFX	Local X force			yes	
LFY	Local Y force			yes	
LFZ	Local Z force			yes	

A.16 Airbag Data Components

For airbags the following data components are available. Versions of LS-DYNA 971 can also generate PART based data for AIRBAGS that use the PARTICLE airbag methods.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
Airbag components					
PR	Pressure		yes	yes	yes
VO	Volume		yes	yes	yes
IE	Internal energy		yes	yes	yes
IN	Mass flow rate in		yes	yes	yes
OU	Mass flow rate out		yes	yes	yes
TM	Total mass		yes	yes	yes
DE	Density			yes	yes
SA	Surface area			yes	yes
TE	Gas temperature			yes	yes
RF	Reaction force			yes	yes
Part components					
PR	Pressure			yes	
MAF	Flow rate through fabric			yes	
MAV	Flow rate through vent			yes	
TA	Total area			yes	
UN	Unblocked area			yes	
TE	Gas temperature			yes	

A.17 Joint Data Components

For joints the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
Basic Joints					
FX	Global X force			yes	yes
FY	Global Y force			yes	yes
FZ	Global Z force			yes	yes
FM	Force Magnitude			yes	yes
MX	Moment in X			yes	yes
MY	Moment in Y			yes	yes
MZ	Moment in Z			yes	yes
MM	Moment Magnitude			yes	yes
General Stiffness Joints					
PHA	Phi angle			yes	yes
DPH	d(Phi)/dt			yes	yes
PHS	Phi stiffness moment			yes	yes
PHD	Phi damping moment			yes	yes
PHT	Phi total moment			yes	yes
THA	Theta angle			yes	yes
DTH	d(Theta)/dt			yes	yes
THS	Theta stiffness moment			yes	yes
THD	Theta damping moment			yes	yes
THT	Theta total moment			yes	yes
PSA	Psi angle			yes	yes
DPS	d(Psi)/dt			yes	yes
PSS	Psi stiffness moment			yes	yes
PSD	Psi damping moment			yes	yes
PST	Psi total moment			yes	yes
EN	Total joint energy			yes	yes
Flexion Torsion Joints					
AA	Alpha angle			yes	yes
DA	d(Alpha)/dt			yes	yes
ALS	Alpha stiffness moment			yes	yes
ALD	Alpha damping moment			yes	yes
ALT	Alpha total moment			yes	yes
BA	Beta angle			yes	yes
DB	d(Beta)/dt			yes	yes
BES	Beta stiffness moment			yes	yes
BED	Beta damping moment			yes	yes
BET	Beta total moment			yes	yes
GA	Gamma angle			yes	yes
DG	d(Gamma)/dt			yes	yes
GSF	Gamma scale factor			yes	yes
EN	Total joint energy			yes	yes

A.18 Cross Section Data Components

For cross sections the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	X Force			yes	yes
FY	Y Force			yes	yes
FZ	Z Force			yes	yes
RM	Force Magnitude			yes	yes
MX	Moment in X			yes	yes
MY	Moment in Y			yes	yes
MZ	Moment in Z			yes	yes
MM	Moment Magnitude			yes	yes
CX	X centroid coordinate			yes	yes
CY	Y centroid coordinate			yes	yes
CZ	Z centroid coordinate			yes	yes
AR	Area of Cross Section			yes	yes

A.19 Subsystem Data Components

For subsystems the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
KE	Kinetic energy			yes	yes
IE	Internal energy			yes	yes
HG	Hourglass energy			yes	yes
KR	Kinetic energy ratio			yes	yes
IM	Internal energy ratio			yes	yes
XM	X momentum			yes	yes
YM	Y momentum			yes	yes
ZM	Z momentum			yes	yes

A.20 Geometric Contact Data Components

For geometric contact entities the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	X Force			yes	yes
FY	Y Force			yes	yes
FZ	Z Force			yes	yes
RM	Force Magnitude			yes	yes
MX	Moment in X			yes	yes
MY	Moment in Y			yes	yes
MZ	Moment in Z			yes	yes
MM	Moment Magnitude			yes	yes

A.21 Nodal Rigid Body Data Components

For nodal rigid bodies the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
DX	X Displacement			yes	yes
DY	Y Displacement			yes	yes
DZ	Z Displacement			yes	yes
DM	Displacement Magnitude			yes	yes
VX	X Velocity			yes	yes
VY	Y Velocity			yes	yes
VZ	Z Velocity			yes	yes
VM	Velocity Magnitude			yes	yes
AX	X Acceleration			yes	yes
AY	Y Acceleration			yes	yes
AZ	Z Acceleration			yes	yes
AM	Acceleration Magnitude			yes	yes
CX	X Co-ordinate			yes	yes
CY	Y Co-ordinate			yes	yes
CZ	Z Co-ordinate			yes	yes
RX	X Rotation			yes	yes
RY	Y Rotation			yes	yes
RZ	Z Rotation			yes	yes
RM	Rotation Magnitude			yes	yes
RVX	X Rotational Velocity			yes	yes
RVY	Y Rotational Velocity			yes	yes
RVZ	Z Rotational Velocity			yes	yes
RVM	Rotational Velocity Magnitude			yes	yes
RAX	X Rotational Acceleration			yes	yes
RAY	Y Rotational Acceleration			yes	yes
RAZ	Z Rotational Acceleration			yes	yes
RAM	Rotational Acceleration Magnitude			yes	yes
D11	Direction Cosine 11			yes	
D12	Direction Cosine 12			yes	
D13	Direction Cosine 13			yes	
D21	Direction Cosine 21			yes	
D22	Direction Cosine 22			yes	
D23	Direction Cosine 23			yes	
D31	Direction Cosine 31			yes	
D32	Direction Cosine 32			yes	
D33	Direction Cosine 33			yes	
LDX	Local X Displacement			yes	yes
LDY	Local Y Displacement			yes	yes
LDZ	Local Z Displacement			yes	yes
LVX	Local X Velocity			yes	yes
LVY	Local Y Velocity			yes	yes
LVZ	Local Z Velocity			yes	yes
LAX	Local X Acceleration			yes	yes

LAY	Local Y Acceleration			yes	yes
LAZ	Local Z Acceleration			yes	yes
LRX	Local X Rotation			yes	yes
LRY	Local Y Rotation			yes	yes
LRZ	Local Z Rotation			yes	yes
LRVX	Local X Rotational Velocity			yes	yes
LRVY	Local Y Rotational Velocity			yes	yes
LRVZ	Local Z Rotational Velocity			yes	yes
LRAX	Local X Rotational Acceleration			yes	yes
LRAY	Local Y Rotational Acceleration			yes	yes
LRAZ	Local Z Rotational Acceleration			yes	yes

A.22 Spotweld Data Components

For spotwelds the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
AX	Axial force			yes	yes
SH	Shear force			yes	yes
LE	Length			yes	yes
FT	Failure Time			yes	yes
FA	Failure			yes	yes
MM	Moment Magnitude			yes	yes
TO	Torsion			yes	yes

A.23 SPC Data Components

For SPC's the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	X Force			yes	yes
FY	Y Force			yes	yes
FZ	Z Force			yes	yes
FM	Force Magnitude			yes	yes
MX	Moment in X			yes	yes
MY	Moment in Y			yes	yes
MZ	Moment in Z			yes	yes
MM	Moment Magnitude			yes	yes

A.24 Boundary Condition Data Components

For SPC's the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
FX	Applied X Force			yes	yes

FY	Applied Y Force			yes	yes
FZ	Applied Z Force			yes	yes
FR	Applied Resultant force			yes	yes
EN	Energy from applied force			yes	yes
FX	Boundary condition motion X Force			yes	yes
FY	Boundary condition motion Y Force			yes	yes
FZ	Boundary condition motion Z Force			yes	yes
FR	Resultant Boundary condition motion force			yes	yes
EN	Energy from Boundary condition motion			yes	yes
MX	Boundary condition motion X Moment			yes	
MY	Boundary condition motion Y Moment			yes	
MZ	Boundary condition motion Z Moment			yes	
MM	Boundary condition moment Magnitude			yes	

A.25 FSI Data Components

For Fluid structural interactions the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
PR	Pressure				yes
FX	X Force				yes
FY	Y Force				yes
FZ	Z Force				yes
FM	Force Magnitude				yes
PL	Porous Leakage				yes
MF	Mass Flux				yes
LFX	Leakage X Force				yes
LFY	Leakage Y Force				yes
LFZ	Leakage Z Force				yes
LFM	Leakage Force Magnitude				yes
TE	Part Temperature				yes
X	X Co-ordinate of Sensor				yes
Y	Y Co-ordinate of Sensor				yes
Z	Z Co-ordinate of Sensor				yes
PR	Pressure				yes
SO	Cpld Solid ID				yes
TE	Temperature at Sensor				yes

A.26 SPH Data Components

For SPH's the following data components are available.

	Component	THF (d3thdt)	XTF (xtfile)	LSDA (binout)	ASCII
DE	Density			yes	yes
EXX	Strain in XX			yes	yes

EYY	Strain in YY			yes	yes
EZZ	Strain in ZZ			yes	yes
EXY	Strain in XY			yes	yes
EYZ	Strain in YZ			yes	yes
EZX	Strain in ZX			yes	yes
EFS	Effective Stress			yes	yes
SXX	Stress in XX			yes	yes
SYX	Stress in YY			yes	yes
SZZ	Stress in ZZ			yes	yes
SXY	Stress in XY			yes	yes
SYZ	Stress in YZ			yes	yes
SZX	Stress in ZX			yes	yes
SM	Smoothing Length			yes	yes

APPENDIX B - T/HIS CURVE FILE FORMAT

A curve file is a file of x, y values which can be read into T/HIS for plotting. It can be written by T/HIS or by another program, or created using a text editor.

The format is as flexible as possible to allow many types of data to be handled.

```

Line 1      : Title
Line 2      : X axis label
Line 3      : Y axis label
Line 4      : Curve label
Line 5      : X, Y point 1
Line 6      : X, Y point 2
:           :
Line n+4    : X, Y point n

```

The X and Y values can be in any format as long as the two values are separated by either a space or comma. Up to 500000 points can be input.

Several curves can be put in one file sequentially, separated by the word CONTINUE. The title and three label lines must be present for each curve.

A comment line may be included anywhere in the file by starting the line with a '\$'.

Comment lines above the curve's title can contain styles and curve tags associated with the corresponding curve.

B.1 Curve STYLE Information

From version 9.1 onwards T/HIS will recognise a line starting **\$ STYLE** as a style request for the following curve and the curve will be displayed with the corresponding style

A **\$ STYLE** line will take the format

\$ STYLE : LINE STYLE, LINE COLOUR, LINE WIDTH, LINE SYMBOLS, SYMBOL FREQUENCY

The following **\$ STYLE** options are available:

Style options	Available styles	Default
LINE STYLE	solid dash none	solid
LINE COLOUR	white red green blue cyan magenta yellow orange turquoise indigo lime	dependent on curve#
LINE WIDTH	fine normal bold heavy	normal

LINE SYMBOLS	triangle square diamond hourglass cross circle start dot null	dependent on curve#
SYMBOL FREQUENCY	frequency number (integer)	

B.2 Curve TAGs

T/HIS will recognise a line starting with **\$ TAG** as a tag for the following curve and the tag can be used in T/HIS to reference the corresponding curve

a **\$ TAG** line will take the format

\$ TAG : tag name

B.3 Curve UNITS

From version 9.4 onwards a T/HIS curve file can also contain information on the Unit system and the X and Y axis units.

A unit system is defined by a line starting with **\$ UNIT SYSTEM** and will take the format

\$ UNIT SYSTEM : system name

The following unit systems names can be specified by using either the full name or just "Un."

U1: m,kg,s (SI)
U2: mm,T,s
U3: mm,kg,ms
U4: mm,gm,ms
U5: ft,slug,s
U6: m,T,s

The X and Y axis units are defined by a line starting with either **\$ X AXIS UNIT** or **\$ Y AXIS UNIT** and take one of the 2 following formats

\$ X AXIS UNIT : unit name
\$ X AXIS UNIT : mass,length,time,angle,temperature

For the 1st format the following predefined unit names are available.

Time	Rotation	Momentum	Energy Den
Energy	Rot Vel	Density	Mass Flow
Work	Rot Accel	Stress	Frequency
Temperature	Length	Strain	Power
Displacement	Area	Force	Thermal Flux
Velocity	Volume	Moment	Force width
Accel	Mass	Pressure	Moment width

If the axis units are NOT one of these predefined units then the second input format can be used to define the unit in terms of it's basic properties. The values for **mass,length,time,angle** and **temperature** should be the powers that are used to describe the unit in terms of it's fundamental dimensions.

Some examples of common units defined using this method are shown below.

Unit	Mass	Length	Time	Angle	Temperature
Time	0.0	0.0	1.0	0.0	0.0
Displacement	0.0	1.0	0.0	0.0	0.0
Velocity	0.0	1.0	-1.0	0.0	0.0
Acceleration	0.0	1.0	-2.0	0.0	0.0
Stress	-1.0	1.0	-2.0	0.0	0.0

B.4 Example

The following example shows a curve file containing 2 curves.

The first curve will be plotted with a bold, solid, green line with triangular symbols every other data point. The curve contains 5 data points and is given a reference tag CURVE_1

The second curve will be plotted with a dashed, white, normal line. No symbols will be displayed. The curve contains 2 data points and has no reference tag.

\$		Comment line
\$ STYLE : solid,green,bold,triangle,2		Style line
\$ TAG : CURVE_1		Tag line
\$		Comment line
CURVE FILE EXAMPLE		;Title
Time		;X axis label
Displacement		;Y axis label
Curve number 1		;Curve label
0	2.0	;1st data pair
1.0	4E-3	
4.0,	4.7	
5 4		
10.0	8.9	
CONTINUE		;End of 1st curve
\$		Comment line
\$		Comment line
\$ STYLE : dash,white,,,		Style line
CURVE FILE EXAMPLE		;Title
Time		
Displacement		
Curve number 2		
0.0	7E2	
2.0	8.7E-9	
Notes:		

The abscissa (x axis) values are assumed to be in the correct order.

The free format allowed for the data points

The style line must contain 5 comma separated words in the order LINE STYLE, LINE COLOUR, LINE WIDTH, LINE SYMBOLS, SYMBOL FREQUENCY to be successfully understood by T/HIS

If any words are unspecified in the style line, as in curve 2, T/HIS will take the default option

APPENDIX C - T/HIS BULK DATA FILE FORMAT

Format of a T/HIS Bulk Data File.

A bulk data file contains a number of curves that share the same X values.

The format of the file is as follows:

```
Line 1      :   Title
Line 2      :   Number of curves (maximum 12)
Line 3      :   Format, see Note 1 below
Line 4      :   Multipliers on values, see Note 2 below
Line 5      :   Axis labels, see Note 3 below
Line 6      :   Line labels, see Note 4 below
Line 7      :   X, Y1, Y2, Y3 ..... point 1
Line 8      :   X, Y1, Y2, Y3 ..... point 2
Line n+6    :   X, Y1, Y2, Y3 ..... point n
```

Up to 500000 points can be read in for each curve.

Note 1 The format for the point data must be given as a standard Fortran format statement, for example (F10.3, 4F10.2). The external brackets around the format must be included. If the data can be read in as a free format then type **FREE** or leave this line blank. Note however, free data is read in more slowly than formatted data.

Note 2 The multipliers are the amount by which the values read in are to be multiplied. For example you may wish to correct from ms to s or units of **G** (gravity) to mm/s². On this line give the multipliers in the order X-value, Y1-value, Y2-value, etc. Separate each multiplier by a space or comma. A zero value is assumed to be 1. If all curves are to be read in as defined leave this line blank.

Note 3 The axis labels are character strings, separated by commas given in the following order.
X-axis label, Y1-axis label, Y2-axis label, etc.

Note 4 The line labels are character strings separated by commas given in the following order.
Line label 1, Line label 2, Line label 3, etc.

A comment line may be included any where in the file by starting the line with a **\$**.

The following shows a bulk data file with three curves and seven points on each curve.

```
$ Comment line
Title of the curves
3
FREE
$ A multiplier of 10 on X values and 5 on Y2 values
10,,5,
x-axis,y1-axis,y2-axis,y3-axis
curve 1,curve 2,curve 3
$ Now for the data
0.0 0.0 1.0 2.0
1.0 1.0 3.0 4.0
2.0 2.0 4.0 5.0
2.4 4.4 5.5 7.4
3.3 7.8 5.8 9.2
4.4 10.0 12.0 13.0
```


APPENDIX D - FILTERING

This Appendix describes the filtering options within T/HIS.

Curves can be filtered to remove high frequency noise. The technique is typically applied to acceleration and force traces. Options available include standard filters (Channel Frequency Classes 60, 180, 600 and 1000 as per British Standard BS AU 228: Part 1: 1989, and the USA's National Highway Traffic Safety Administration (NHTSA) FIR filter). The standard filters (except the FIR filter) are all special cases of the Butterworth filter.

D.1 Curve Regulation

All filtering options require the curves to have a constant time increment between points. This will generally be the case if the curves are LS-DYNA time history results. If not, the REGULARISE option will convert the curve to constant time increment.

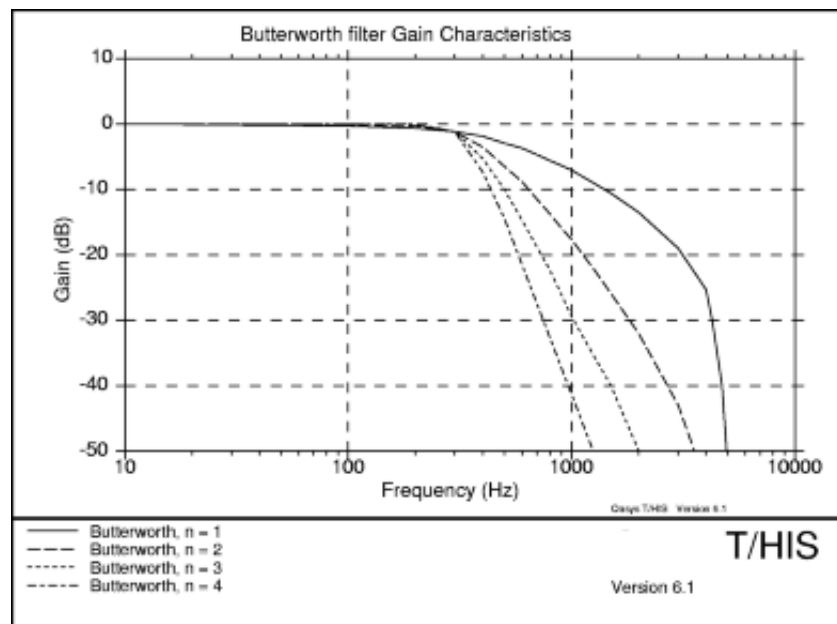
Typically the time increment should be at least 10 times the cut-off frequency; 10kHz (a 0.0001 second interval time base) is a good choice for automotive crash applications.

D.2 Use of the Butterworth Filter Option

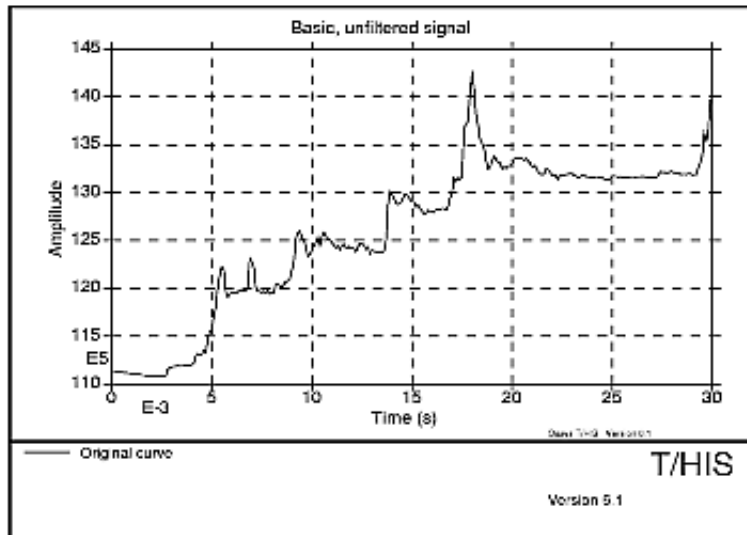
The Butterworth filter is a low pass filter with two input variables; order and cut-off frequency.

The order of the filter controls the roll-off rate, as shown here in the figure (right)

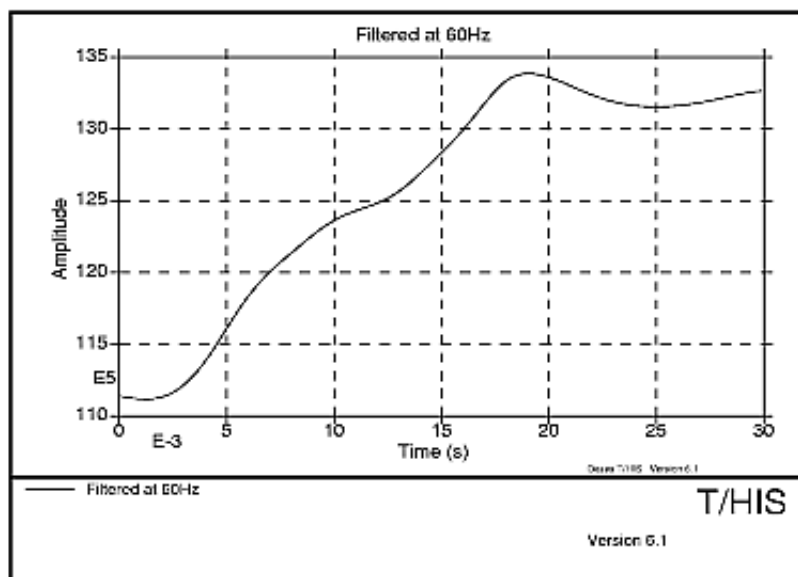
This is a 300Hz filter. It can be seen that higher orders attenuate the results more quickly: they have a higher roll-off rate.



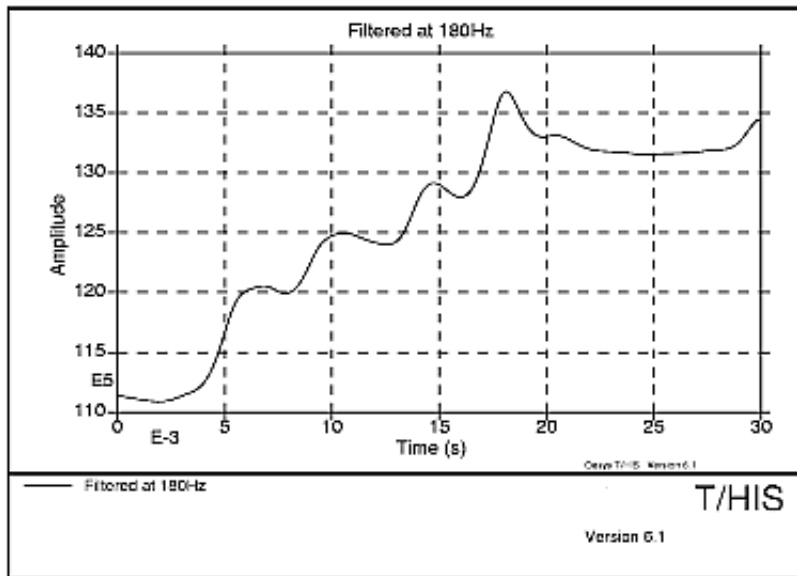
The cut-off frequency is the frequency at which the gain of the filter is -3dB (i.e. the magnitude of signals at this frequency is halved by the filter). The lower the frequency the less noise passes through; but any peaks in the signal tend to get reduced in magnitude and delayed in time.



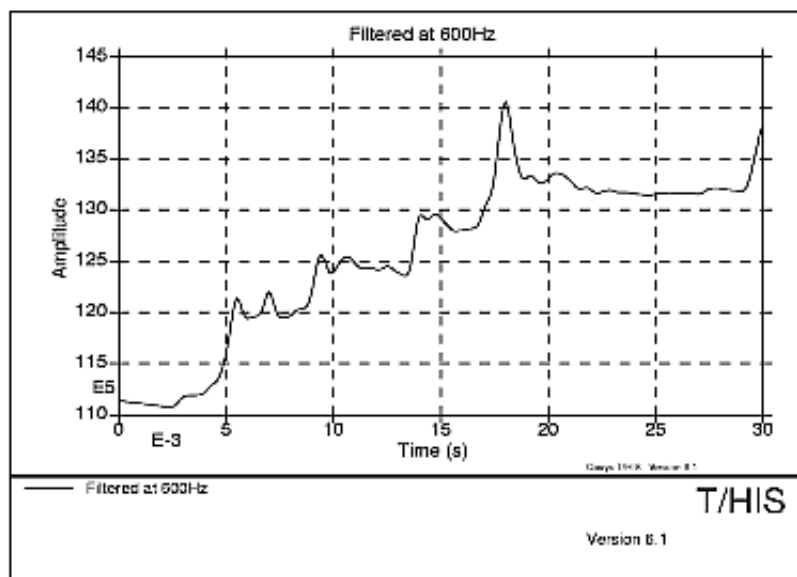
Unfiltered Signal



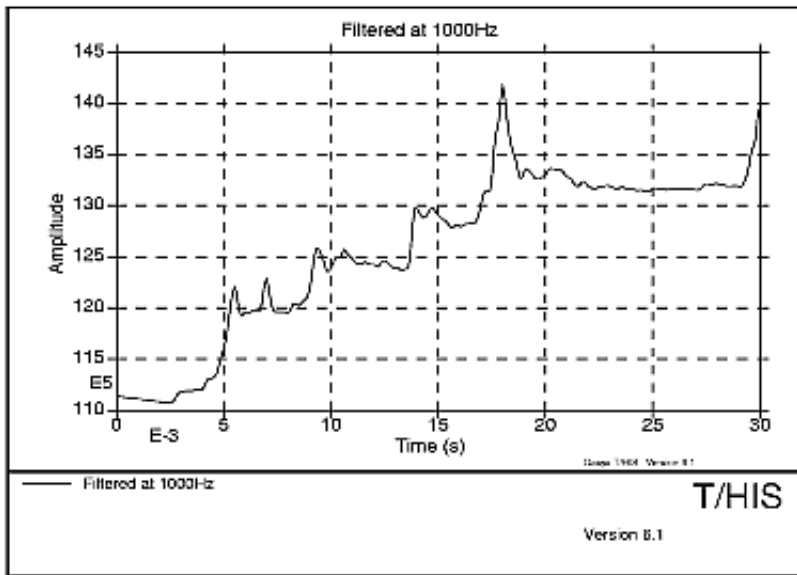
Filtered at 60Hz



Filtered at 180Hz



Filtered at 600Hz



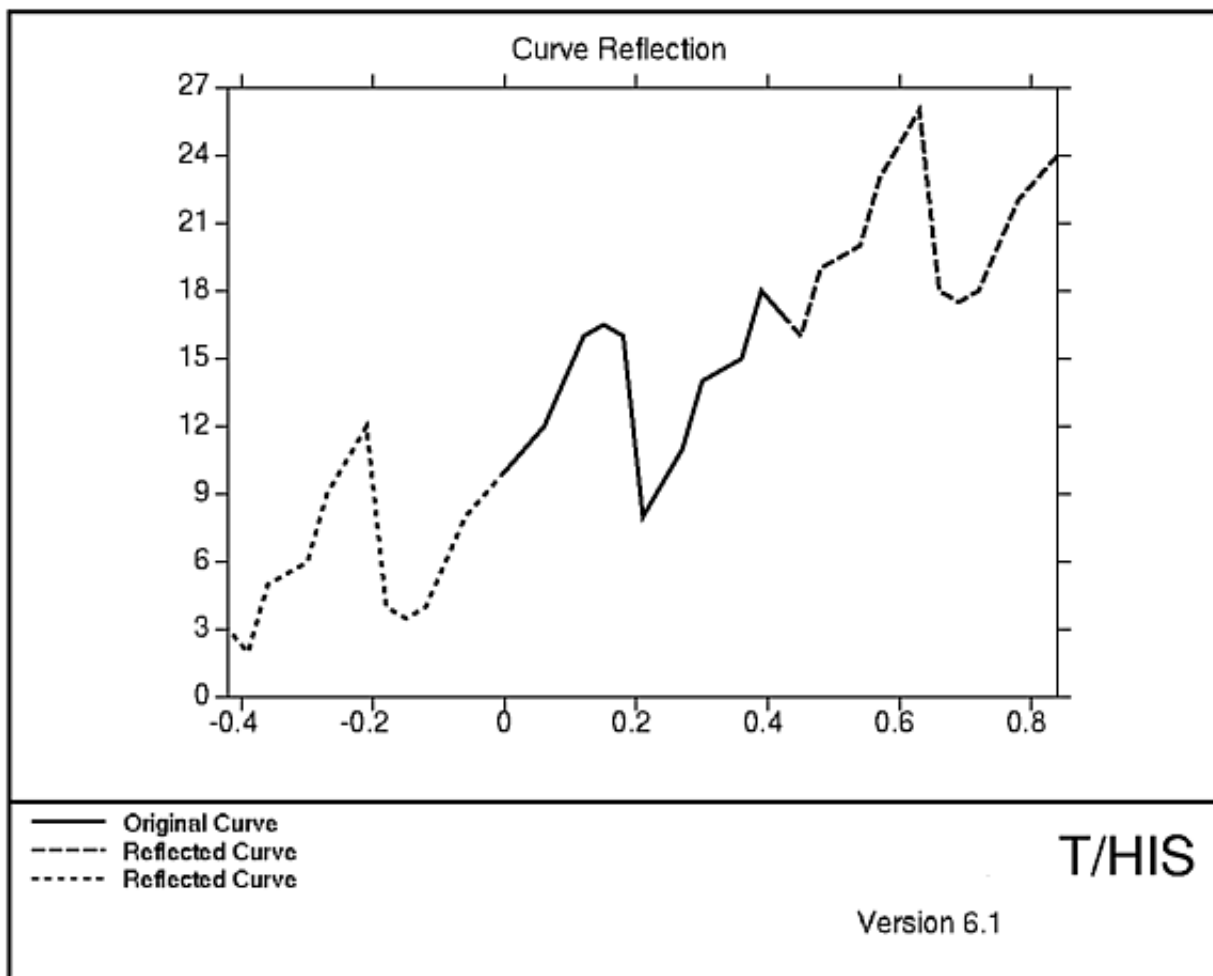
Filtered at 1000Hz

The above figures show examples of filtering frequency using the four standard SAE filters (60, 180, 600 and 1000 Hz cut-off frequencies: see below). These show clearly how the original signal is smoothed.

D.3 Butterworth Filter Implementation

Two refinements have been incorporated:

- Reflection of beginning and end of curves to minimise end-effects of filtering (see the figure below).
- The curve is first passed forwards through the filter, then the resulting signal is passed through backwards. This procedure minimises phase change errors. The poles and zeros of the filter are calculated such that the desired cut-off frequency is achieved after two passes.



D.4 Standard SAE Filter Options

Channel Filter Classes 60, 180, 600 and 1000 are Butterworth filters with the following parameters:

Filter Class	Cut-off Frequency	Order
60	100Hz	2
180	300Hz	2
600	1000Hz	2
1000	1650Hz	2

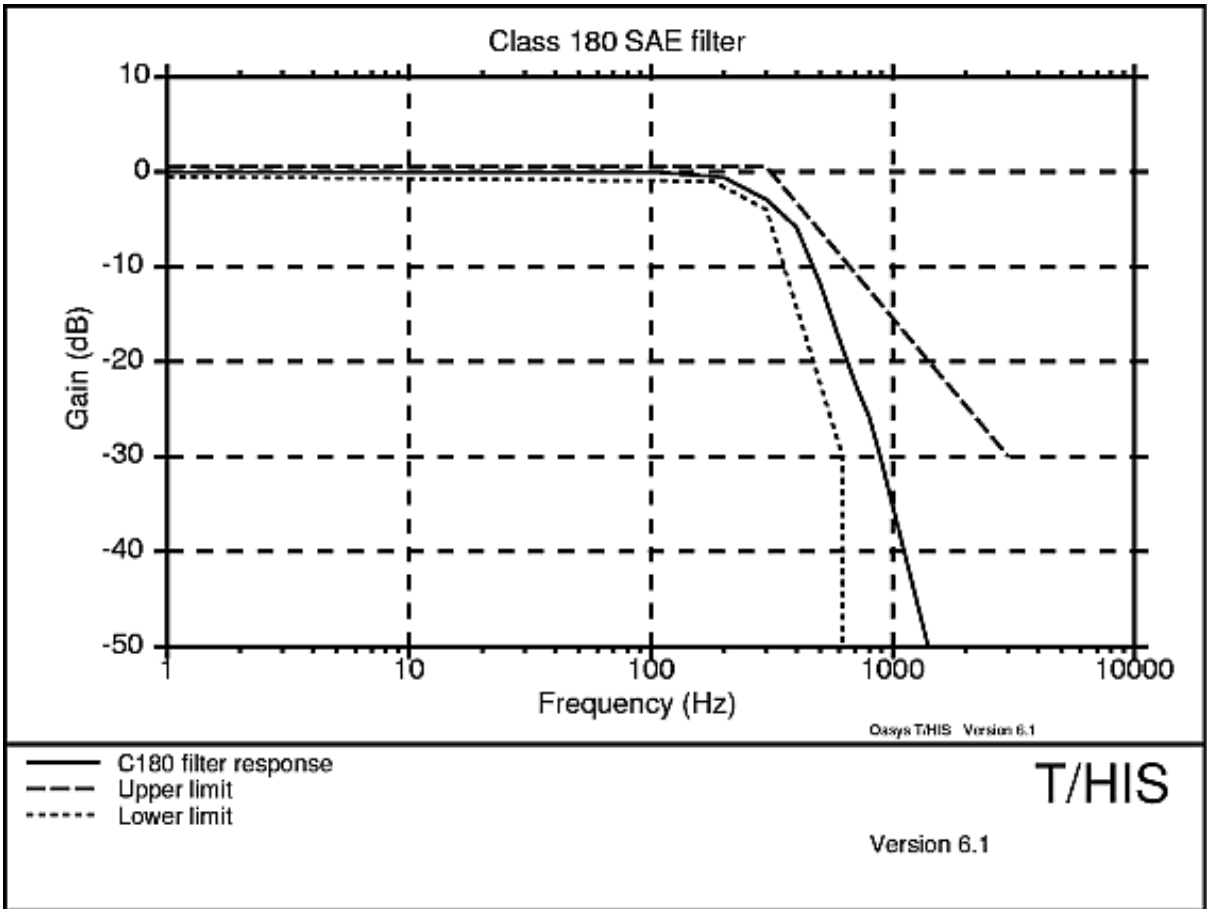
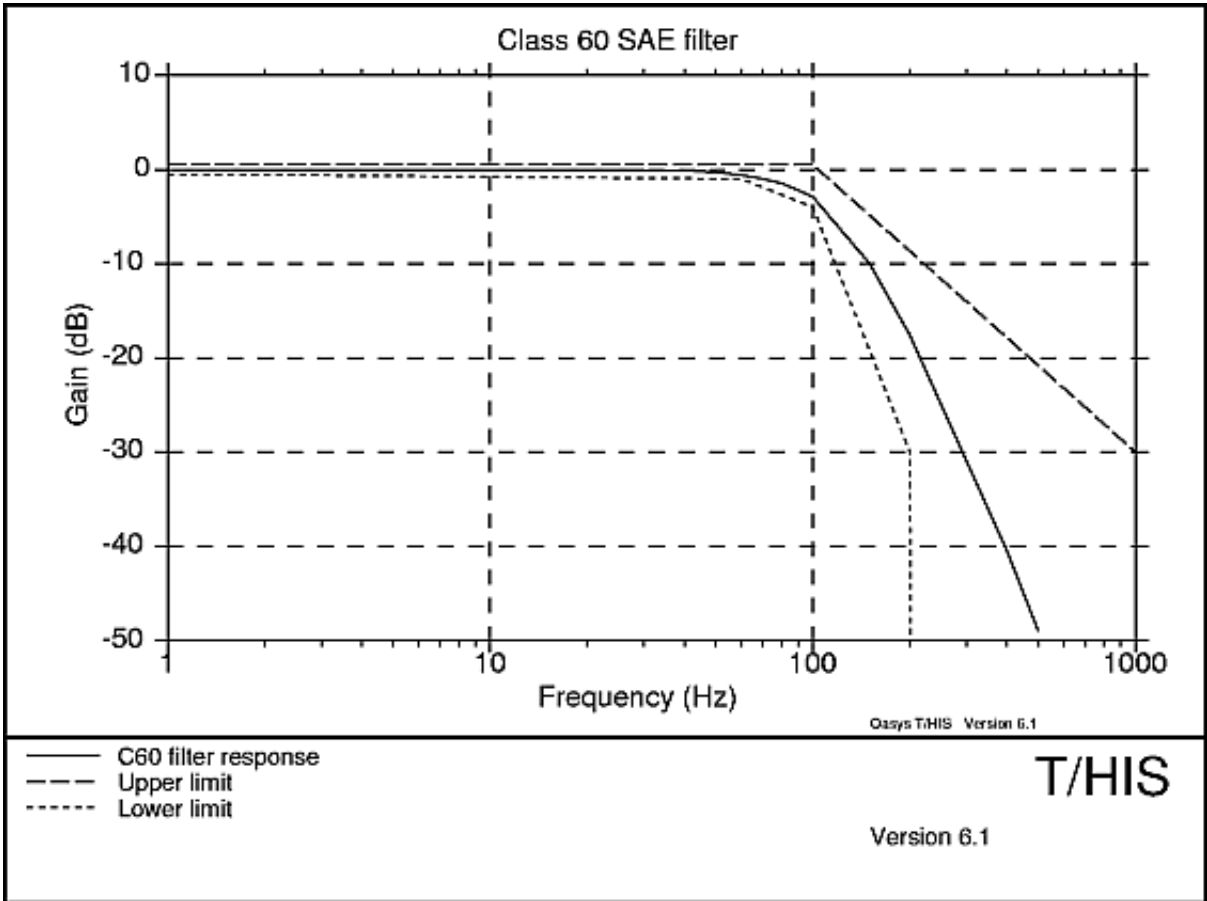
The gain characteristics are compared with the limits given in BS AU228 in the following four figures.

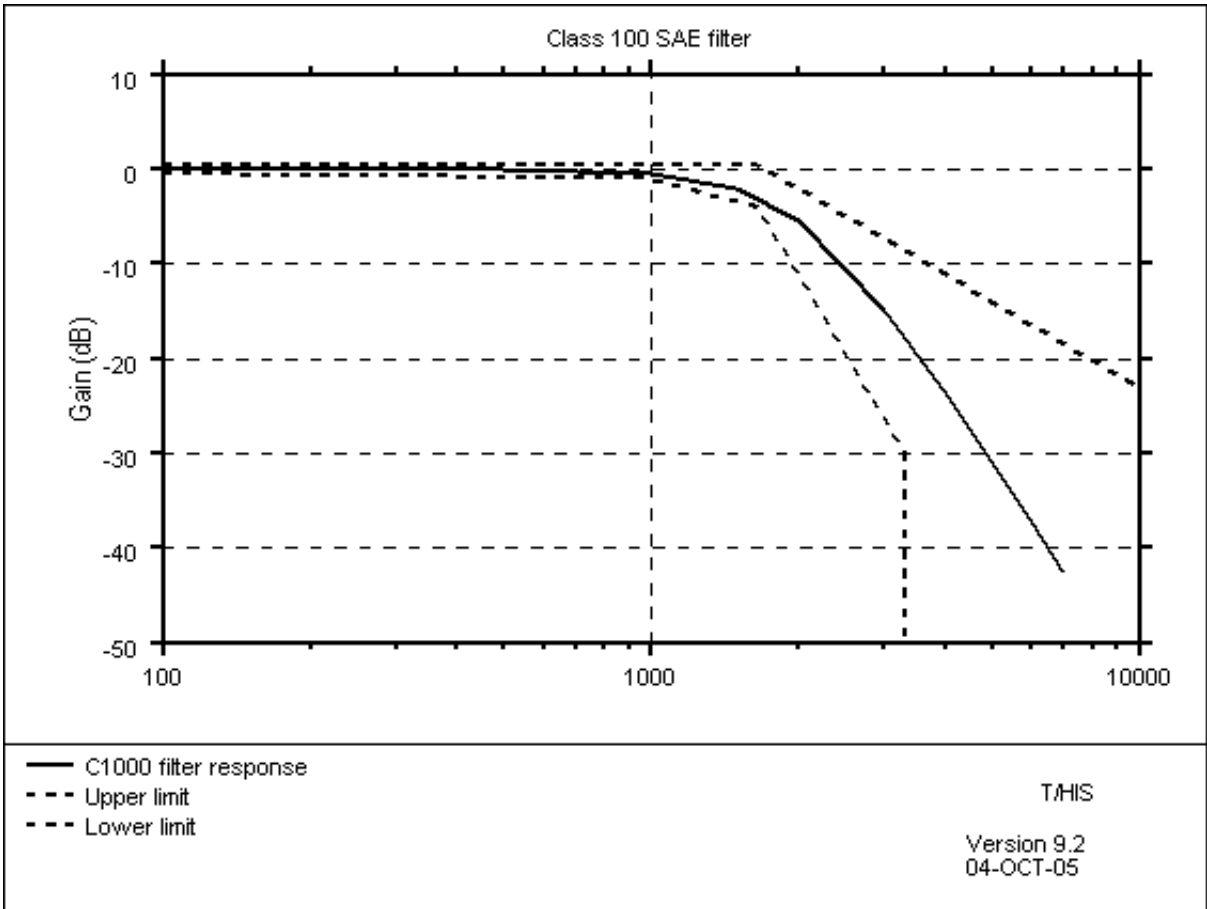
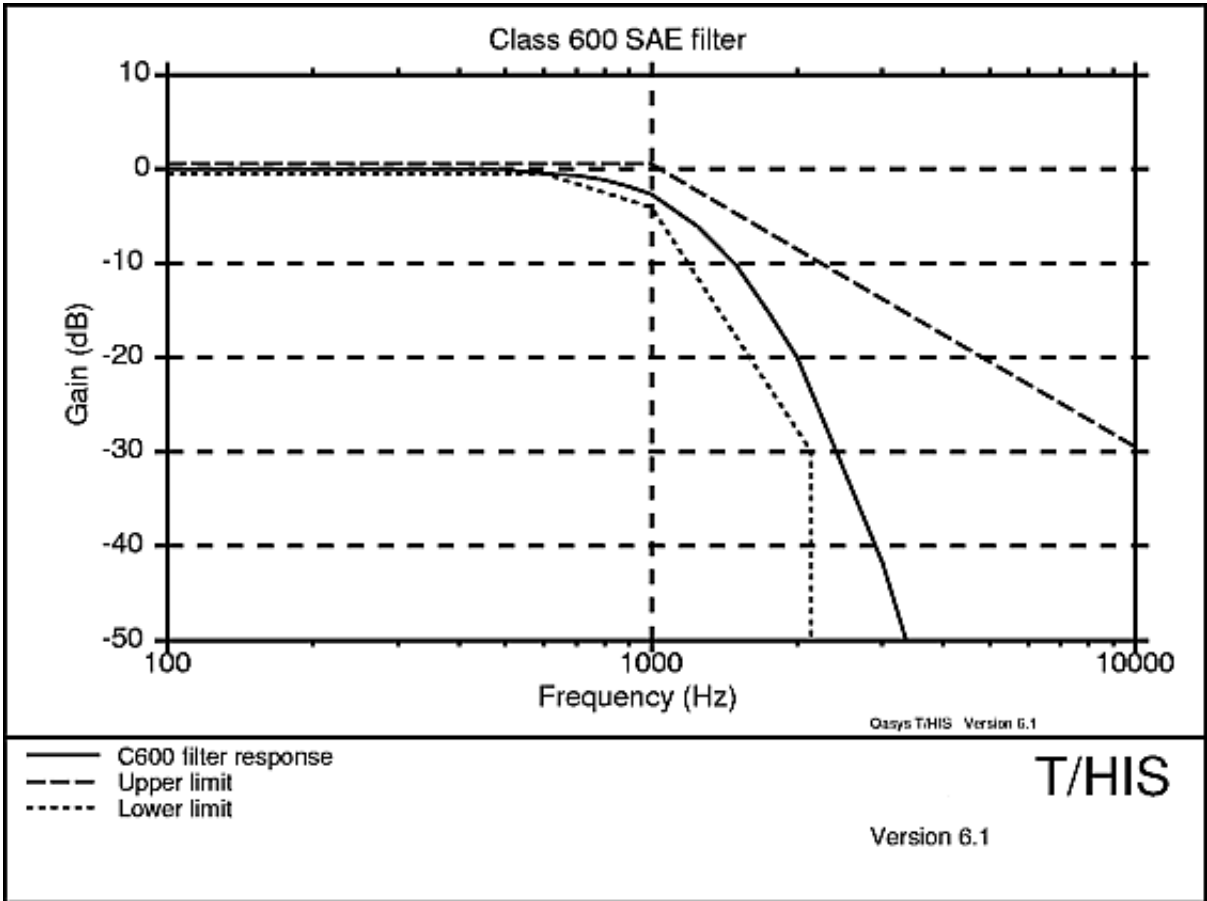
D.5 Standard FIR filter option

The FIR filter (Finite Impulse Response) is specified by NHTSA. It is used for filtering thoracic accelerations from side impact dummies; the filtered accelerations are then used in calculation of TTI (Thoracic Trauma Index). Its characteristics are:

- A passband frequency of 100Hz.
- A stopband frequency of 189Hz.
- A stopband gain of -50dB.
- A passband ripple of 0.0225dB.

It is based on a standard Fortran programme available from NHTSA.





APPENDIX E - INJURY CRITERIA

T/HIS has the option to calculate two of the injury criteria that are used currently in occupant protection. These are the head impact criteria or HIC value and 3ms clip value. These criteria are defined as follows:

E.1 HIC Value

The HIC value is calculated from the resultant acceleration time history of the head centre of gravity filtered through a class 1000 filter. The HIC value is then calculated from;

$$\text{HIC} = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a \, dt \right]^{2.5} (t_2 - t_1)$$

Where a is the acceleration expressed in g , and t_1 and t_2 are any two points in time. It is now usual for an upper limit on the range $t_2 - t_1$ of 36ms to be applied.

E.2 3ms Clip

The 3ms clip value is the maximum value of acceleration that is exceeded for a period of not less than 3 ms. This is not an easily comprehended definition: the following may be of more use:

- At each time point T , take the interval (T to $T+3\text{ms}$);
- (1)
- (2) In this interval find the **lowest** acceleration value;
- (3) The "3ms Clip" value is the interval (T to $T+3\text{ms}$) which has the **largest** "lowest" value as calculated in (2) above.

So, perhaps, a better definition might be: "the 3ms interval with the highest lowest acceleration value".

E.3 Viscous Criteria

The VC value is calculated from a compression time history using the following formula;

$$VC = A[V_{(t)}C_{(t)}]$$

where $C_{(t)} = \frac{D_{(t)}}{B}$

$$V_{(t)} = \frac{8[D_{(t+1)} - D_{(t-1)}] - [D_{(t+2)} - D_{(t-2)}]}{12dt} \quad (\text{ECER95 regulations})$$

$$V_{(t)} = \frac{dD}{dt} \quad (\text{IIHS regulations})$$

$$D_{(t)} = \text{Rib Compression}$$

$$A = \text{Constant (1.3 frontal, 1.0 side)}$$

$$B = \text{Constant (0.229 frontal, 0.140 side)}$$

E.4 Acceleration Severity Index

The ASI value is calculated from 3 acceleration time histories using the following formula;

$$ASI_{(t)} = \left[\left(\frac{ax}{xl} \right)^2 + \left(\frac{ay}{yl} \right)^2 + \left(\frac{az}{zl} \right)^2 \right]^{0.5}$$

Where : ax, ay, az are the X,Y,Z accelerations of the vehicle averaged over a 50ms moving interval.

xl, yl, zl are acceleration limits $xl = 12g$ $yl = 9g$ $zl = 10g$.

The acceleration input curves should be in units of g. If the input curves are in any other unit a conversion factor can be input to convert back to g.

When selecting input curves it is assumed that the X curve 'is numerically the first curve (the one with the lowest id) of the ones selected and the Z curve is the last. If they are in a different order then the acceleration limits can be modified to reflect the different order. For more information on ASI see BS EN 1317-1.

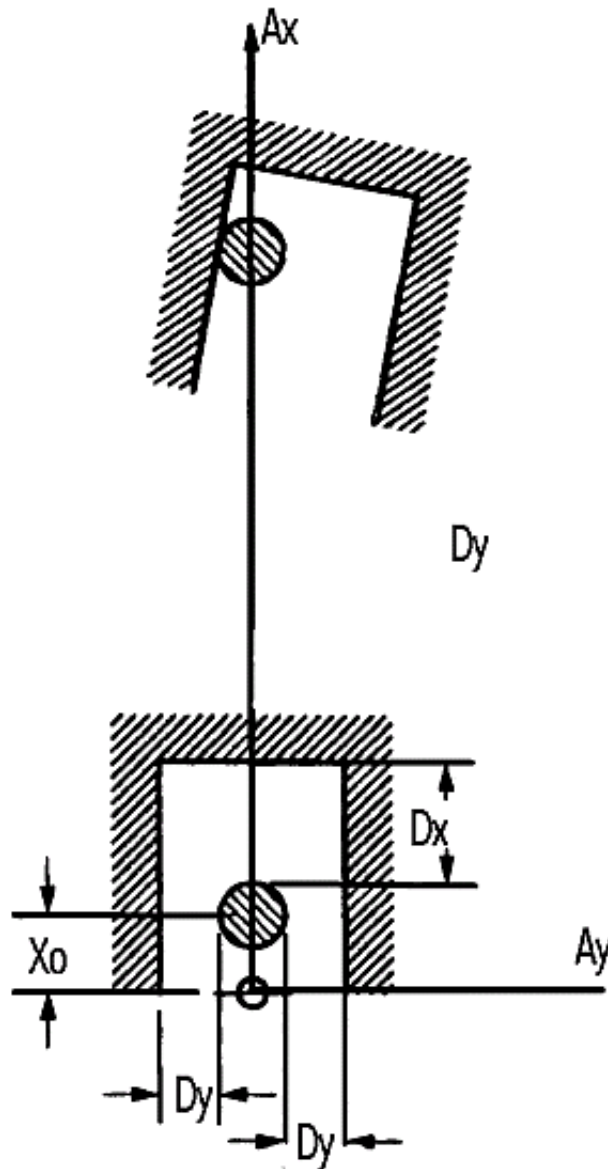
E.5 Theoretical Head Impact Velocity & Post Impact Head Deceleration

The theoretical head impact velocity concept has been developed for assessing occupant impact severity for vehicles involved in collisions with road vehicle restraint systems. The occupant inside the vehicle is considered to be a freely moving object that, as the vehicle changes its speed due to the contact with the restraint system, continues moving until it strikes the vehicle interior. The velocity magnitude at the time of impact with the vehicle interior is considered to be a measure of the vehicle to vehicle restraint system impact severity.

After impact the head is assumed to continue moving with the vehicle during the rest of the impact event. The post impact head deceleration (PHD) is calculated as the peak value using a 10ms moving average of the resultant vehicle acceleration after the THIV impact.

The THIV calculation requires the following inputs

- Horizontal Vehicle Acceleration Time History (A_x)
- Lateral Vehicle Acceleration Time History (A_y)
- Yaw Rate Time History
- Horizontal Distance from the occupants head to vehicle (D_x)
- Lateral Distance from the occupants head to vehicle (D_y)



For more information on THIV and PHD see BS EN 1317-1.

E.6 Biomechanical neck injury predictor (NIJ)

The biomechanical neck injury predictor is a measure of the injury due to the load transferred through the occipital condyles. Its calculation combines the neck axial force and the flexion/extension moment about the occipital condyles.

It is used in association with the USSID dummy for standard American frontal impact tests.

The shear force (F_x), axial force (F_z) and bending moment (M_y) are measured by the dummy upper neck load cell for the duration of the crash, using force and moment definitions consistent with SAE J221/1. T/HIS will calculate the bending moment using the equation:

$$M_y = M_y' - e \cdot F_x$$

Where e is the e distance specified in the input window, F_x is the shear force.

Shear force, axial force and bending moment must be filtered using an SAE Channel Frequency Class 600 filter (C600) for the purposes of calculation.

During the collision, the Axial Force (F_z) can be in either tension or compression whilst the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in 4 possible loading conditions corresponding to the 4 curves output by T/HIS; tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), and compression-flexion (N_{cf}). At each point in time only one of these 4 conditions can be met, hence the NIJ value is calculated for that condition and the value for the other 3 conditions is considered a value of zero..

The expression for calculating each NIJ loading condition is given by:

$$NIJ = (F_z/F_{zc}) + (M_{ocy}/M_{yc})$$

where F_z and M_{ocy} are as defined above, F_{zc} and M_{yc} refer to the axial force and Bending moment critical values, given below:

The values of F_{zc} and M_{yc} vary depending on the occupant, the occupants position and the sign of **F_z** and **M_{ocy}**

For the dummy to pass the test, the following conditions must be met:

- (i) None of the 4 NIJ values may exceed 1.0 at any time during the event
- (ii) Peak Tension Force (F_z), measured at the upper neck load cell, may not exceed the specific dummy's limit (e.g. 2070N for the Hybrid III small female) at any time
- (iii) Peak Compression Force (F_z), measured at the upper neck load cell, may not exceed the specific dummy's limit (e.g. 2520N for the Hybrid III small female) at any time

For more information on the use and calculation of NIJ, refer to the FMVSS 208 document

E.7 The Thoracic Trauma Index (TTI)

The Thoracic Trauma Index is used as a predictor of thoracic injury severity in the USSID dummy in standard American Side Impact tests.

The Index considers both rib and Thorax acceleration in an impact.

The expression for calculating TTI is given by:

$$TTI = (G(R) + G(LS))/2$$

Where $G(R)$ is the greater of the peak accelerations of either the upper or lower rib, expressed in g, and $G(LS)$ is the peak acceleration in the lower spine (T12), expressed in g.

For the dummy to pass the test, the following conditions must be met:

- (i) The TTI value must not exceed;
 - (a) 85g for a passenger car with 4 side doors, and for any multipurpose vehicle, truck or bus
 - (b) 90g for a passenger car with 2 side doors
- (ii) The peak lateral acceleration of the pelvis shall not exceed 130g
- (iii) Any side door, struck by the moving deformable barrier, shall not separate totally from the car.
- (iv) Any door not struck by the moving deformable barrier must meet the following requirements;
 - (a) The door shall not disengage from the latched position
 - (b) The latch shall not separate from the striker
 - (c) The hinge components shall not separate from each other or from their attachment to the vehicle
 - (d) Neither the latch nor the hinge systems of the door shall pull out of their anchorage

For more information on the use and calculation of TTI, refer to the FMVSS 214 document

APPENDIX F - Curve Correlation

COR1 and COR2

The Correlation functions COR1 and COR2 provide a measure of the degree to which two curves match. When comparing curves by eye, the quality of correlation may be judged on the basis of how well matched are the patterns of peaks, the overall shapes of the curves, etc, and can allow for differences of timing as well as magnitude. Thus a simple function based on the difference of Y-values (such as T/HIS ERR function) does not measure correlation in the same way as the human eye. The T/HIS correlation function attempts to include and quantify the more subtle ways in which the correlation of two curves may be judged.

The correlation function may be applied to any two curves whose x-values increase monotonically (e.g. responses versus time). The results are independent of the units used, e.g. milliseconds or seconds are both acceptable. The sign of the y-values is not important.

Only the overlap time period is considered (i.e. the range of x-values for which both curves have a y-value). The time period (range of X-values) and maximum absolute Y-value are used to non-dimensionalise the curves such that x-values run from 0 to 1, and the maximum absolute y-value is 1.

Five measures of correlation are calculated. Each is given equal weighting. The final correlation score is given as a percentage - two identical curves would score 100%.

The first two measures require identification of peaks in the curves. Up to 10 peaks in each curve will be considered. A peak is defined as a local maximum (or in the case of negative y-values a minimum), satisfying the following criteria:

- Absolute y-value at least 0.5
- Separated on the x-axis from any larger peak by at least 0.1
- Separated from any larger peak by a trough (local minimum) at least 0.2 deep.

Peaks of positive or negative signs are considered. Peaks are matched only against peaks of the same sign in the other curve.

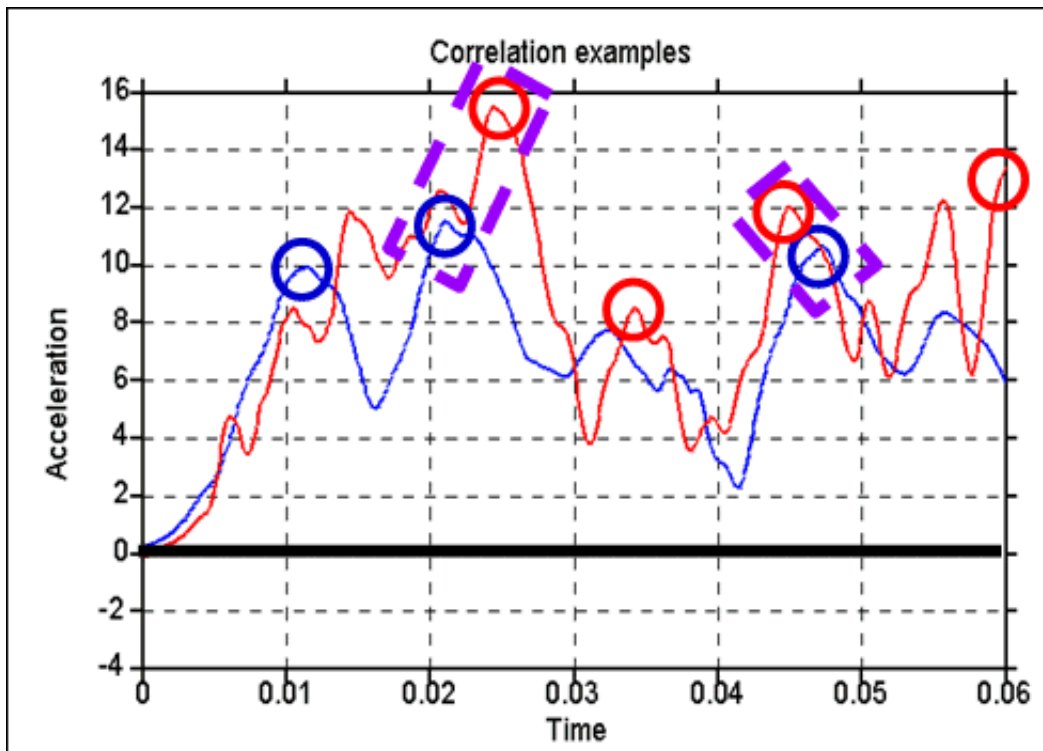
Measure 1 - Peak values

For each identified peak in Curve A, find the maximum value in Curve B within a time tolerance of the peak in Curve A. Points are lost according to the error in y-values compared to a tolerance limit. Repeat for peaks in curve B against values in Curve A.

This measure allows for the situation where curves are similar but the peaks are more strongly delineated in one of the curves, such that the program does not recognise the other curve as having a peak in that location.

Measure 2 - Peak matching

For each identified peak in Curve A, find the closest identified peak in Curve B. Points are lost according to the largest error (timing or y-value) compared to tolerance limits; points are also lost if there is no corresponding peak in Curve B. Repeat for Curve A peaks matched against those of Curve B.



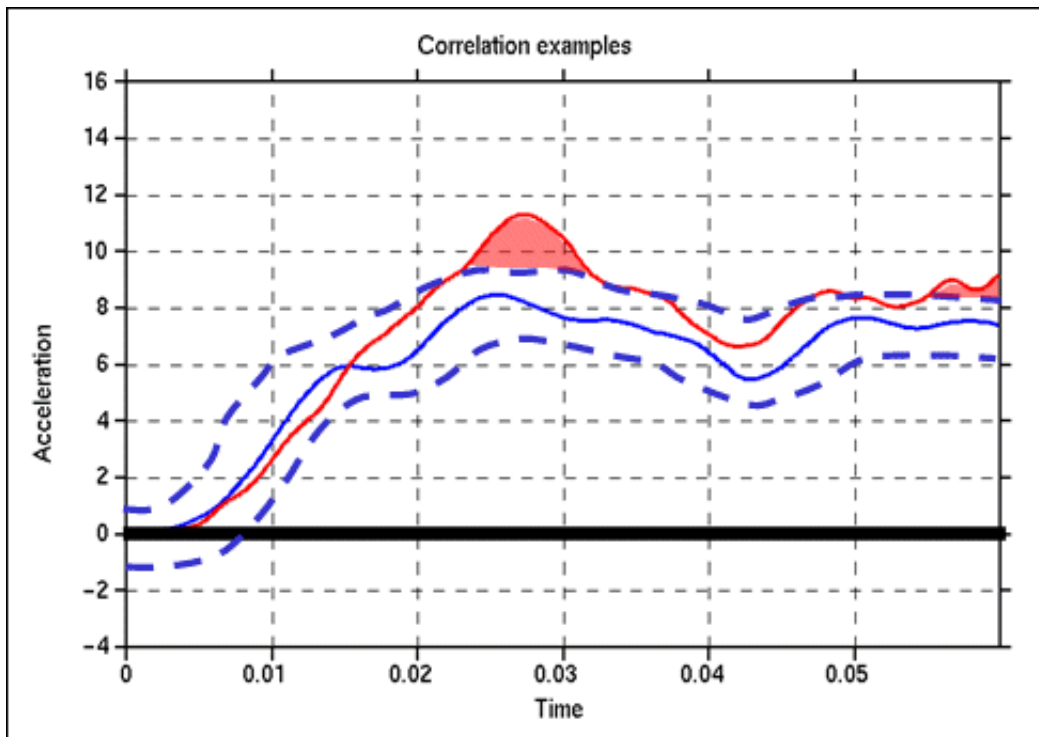
This measure picks up matching of primary and secondary peaks in the curves, which may correspond to physical events.

Measure 3 - Area matching

The integral of each curve is calculated. Points are lost according to the difference compared to a tolerance limit.

Measure 4 - Curve shape (low frequency excursion)

The curves are filtered. A band is drawn around filtered curve A (using positive and negative offsets in x and y). The area of excursions of filtered Curve B outside the band is calculated. Points are lost according to the excursion area compared to a tolerance limit. The process is repeated for filtered Curve A excursions from a band drawn around filtered curve B



Measure 5 - Curve shape (full curve)

The same as Measure 4 except that the curves are not filtered and different tolerance limits and band sizes may be used.

Output

T/HIS prints the overall correlation percentage and the marks from each measure to the screen or to a text file. A new curve is created from each input curve showing the identified peaks (used in measures 1 and 2). As the same curve could be used as input to multiple correlations the correlation percentage is stored internally in T/HIS with the 2 output curves NOT the input curves.

The correlation percentage can be accessed from within FAST-TCF scripts by requesting the "correlate" property for either of the 2 output curves.

e.g. operation correlate strict curve_1 curve_2 tag curve_3 curve_4

Calculate correlation between "curve_1" and "curve_2". Tag the curves containing the peaks as "curve_3" and "curve_4"

tab output.txt curve_3 correlate

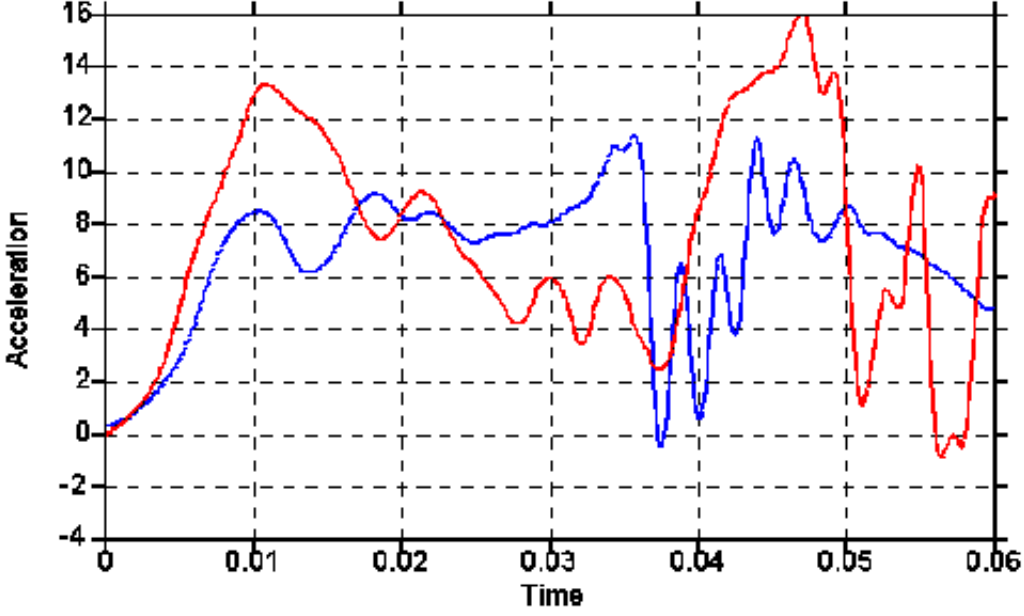
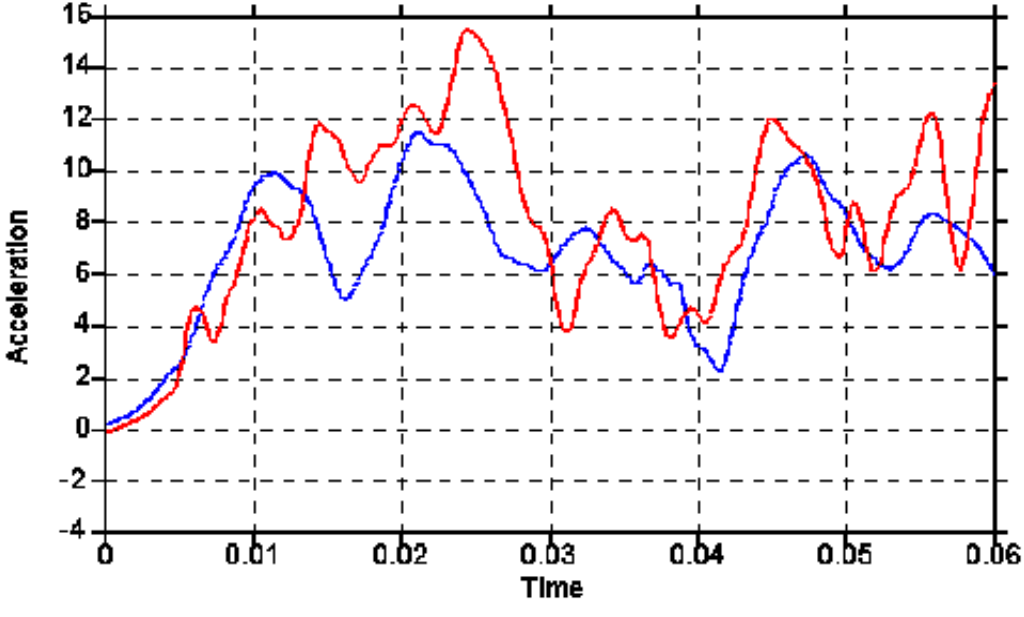
Output the curve correlation value from "curve_3" to the file "output.txt"

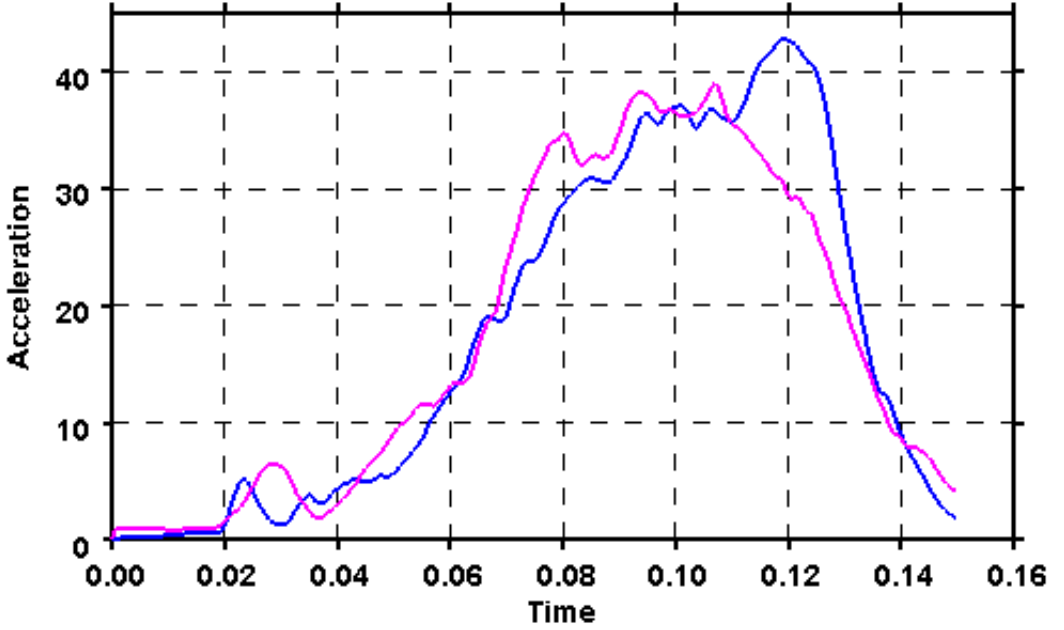
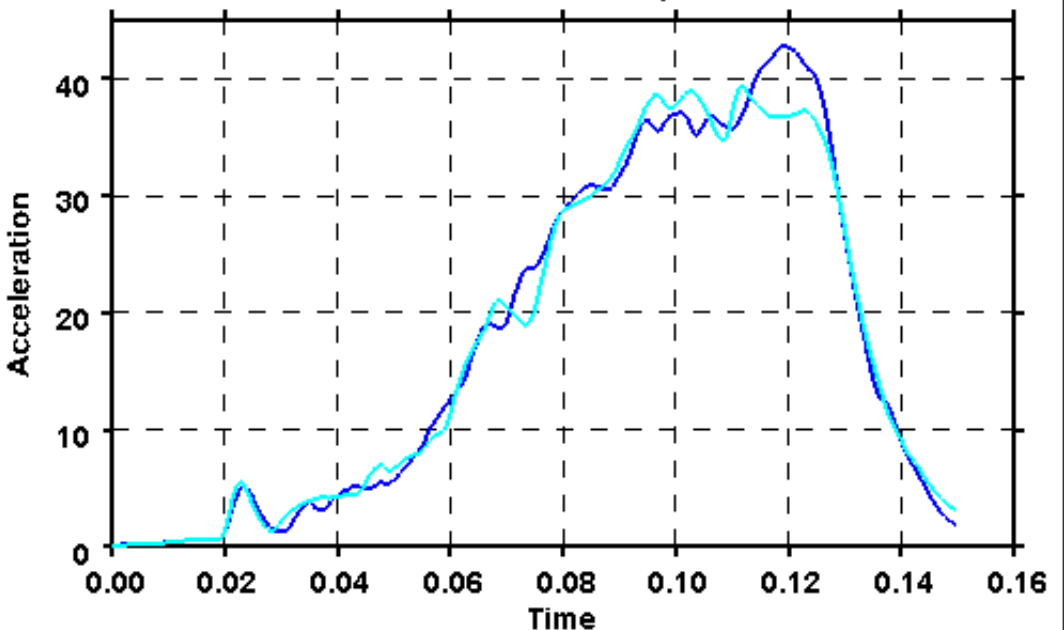
taba output.txt curve_4 correlate

Append the curve correlation value from "curve_4" to the file "output.txt"

Selection of Parameters

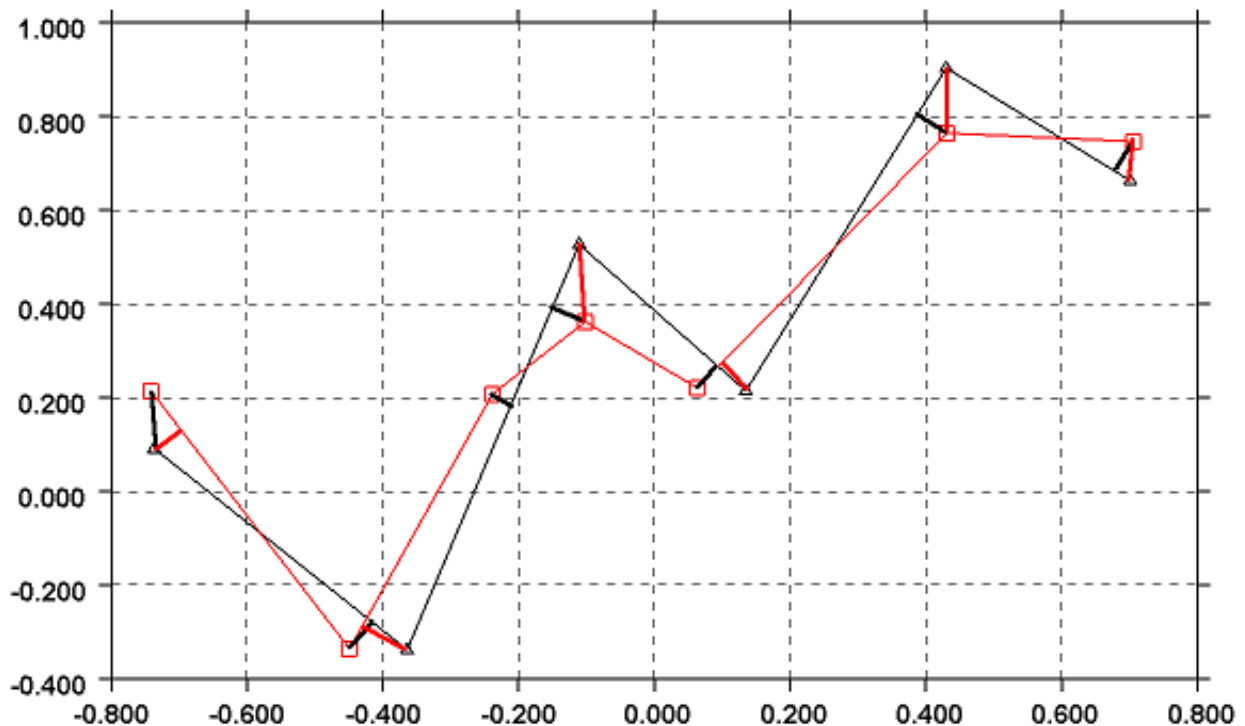
The Correlation algorithm has many tolerance limits and other inputs. Two sets of these parameters have been pre-selected, to offer strict or less strict judgement of correlation (buttons COR1 and COR2 in the Automotive menu). It is expected that, if COR1 rates Curves A and B as better correlated than C and D, then COR2 would also rate the pairs of curves in the same order. The percentage correlation would be greater in each case from COR2 than from COR1. COR1 will provide a greater difference (discrimination) between well-correlated and very well-correlated pairs of curves; while COR2 will provide greater discrimination between averagely-correlated and poorly-correlated pairs of curves. The purpose of offering both versions of the correlation function is to allow the user to select a calibration of the function appropriate to the typical input curves used.

Examples	COR1	COR2
Correlation examples 	17%	42%
Correlation examples 	27%	62%

Correlation Examples 	70%	88%
Correlation Examples 	84%	92%

COR3

The Correlation function COR3 provides another measure of the degree to which two curves match based on the distance between the two curves.



This function first normalises the curves using two factors, specified either by the user or defaults calculated by the program (the maximum absolute X and Y values of both graphs).

For each point on the first normalised curve, the shortest distance to the second normalised curve is calculated (the thick black lines on the image above). The root mean square value of all these distances is subtracted from 1 and then multiplied by 100 to get an index between 0 and 100.

The process is repeated along the second curve (the thick red lines show the distances) and the two indices are averaged to get a final index. The higher the index the closer the correlation between the two curves.

Note that the choice of normalising factors is important. Incorrect factors may lead to a correlation index outside the range of 0 to 100.

APPENDIX G - The ERROR Calculation

The ERROR function outputs a number of values to indicate the degree of correlation between 2 curves. The function requires two input curves

- A reference curve to compare against (the first curve selected)
- The curve to compare against the reference

Once 2 curves have been selected the a check is carries out to see if the two curves contain the same number of points and if the range of x-axis values the same for the two curves. If any inconsistencies are found then a warning message is generated.

The following values are then calculated

Maximum difference and time of variation

Maximum difference as a %age of the reference value at the same time

Maximum difference as a %age of the peak reference value

Average difference

Average difference as a %age of the peak reference value

$$\text{Area weighted difference} = \left(\frac{\int |y_r - y_c| dx}{\frac{1}{2} \left(\int y_r dx + \int y_c dx \right)} \right)$$

where y_r = Reference Curve
 y_c = Data Curve

T/HIS Regression coefficient.

$$R^2 = \left[1 - \frac{\sum (y_c - y_a)^2}{\sum y_a^2 - \frac{\sum y_a^2}{n}} \right]$$

y_c = Data Curve

y_a = Average of Data and Reference Curve = $\frac{1}{2}(y_c + y_r)$

n = Number of Data Points

This is a value between 0 and 1 where 1 means 100% correlation

APPENDIX H - The "oa_pref" preference file

This file contains code-specific preferences that can be used to modify the behaviour of T/HIS. It is optional and, where entries (or the whole file) are omitted T/HIS will revert to its default settings.

"oa_pref" naming convention and locations

The file is called "oa_pref". It is looked for in the following places in the order given:

- The optional administration directory defined by the environmental variable (**\$OA_ADMIN** or **\$OA_ADMIN_xx** where xx is the release number).
- The site-wide installation directory defined by the environment variable (**\$OA_INSTALL**)
- The user's home directory: **\$HOME** (Unix/Linux) or **%USERPROFILE%** (Windows)
- The current working directory

See [Installation organisation](#) for an explanation of the directory structure.

All four files are read (if they exist) and the last preference read will be the one used, so the file can be customised for a particular job or user at will.

Files do not have to exist in any of these locations, and if none exists the programme defaults will be used.

On Unix and Linux:

\$HOME on Unix and Linux is usually the home directory specified for each user in the system password file. The shell command "**printenv**" (or on some systems "**setenv**") will show the value of this variable if set. If not set then it is defined as the "~" directory for the user. The command "**cd; pwd**" will show this.

On Windows:

%USERPROFILE% on Windows is usually **C:\Documents and Settings\<user id>**. Issuing the "**set**" command from an MS-DOS prompt will show the value of this and other variables.

Generally speaking you should put

- Organisation-wide options in the version in **\$OA_ADMIN_xx** and/or **\$OA_INSTALL**,
- User-specific options in **\$HOME / %USERPROFILE%**
- Project-specific options in the current working directory.

The file contains preferences for the SHELL (lines commencing shell*), THIS (lines commencing this*), D3PLOT (lines commencing d3plot*), PRIMER (lines commencing primer*) and REPORTER (lines commencing reporter*). All lines take the format <preference name> <preference value>.

The general copy of the preference file should be present in the [\\$OA_ADMIN_xx](#) and/or [\\$OA_INSTALL](#) directory. This should contain the preferences most suitable for all software users on the system.

An individual's specific preferences file can be stored in the individual's home area. This can be used to personally customise the software to the individual's needs.

Whenever one of the programs whose preferences can be stored in the oa_pref file is fired up, the program will take preferences first from the general preference file in the [\\$OA_ADMIN_xx](#) directory (if it exists) then the [\\$OA_INSTALL](#) directory, then from the file in the user's home area, then from the current working directory.

Preferences defined in the general oa_pref file can be modified in the user's personal file but they can't be removed by it.

From version 9.4 onwards preferences can be locked. If a preference is locked it cannot be changed in an oa_pref file in a more junior directory. To lock a preference use the syntax '**this#**' rather than '**this***'.

The interactive Preferences Editor

You are free to edit oa_pref files by hand, but there is an interactive "Preferences Editor" that may be called from within T/HIS that makes the job much easier.

It is started by [Options, Edit Preferences](#) or through the Preferences Button in the Tool menu

The preferences editor reads an XML file that contains all possible preferences and their valid options, and allows you to change them at will. In this example the user is changing the background colour in D3PLOT.

Note that changes made in the Preferences editor will not affect the current session of D3PLOT, they will only take effect the next time it is run.

If you have write permission on the oa_pref file in the \$OASYS directory you will be asked if you want to update that file, otherwise you will only be given the option of updating your own file in your \$HOME / \$USERPROFILE directory.

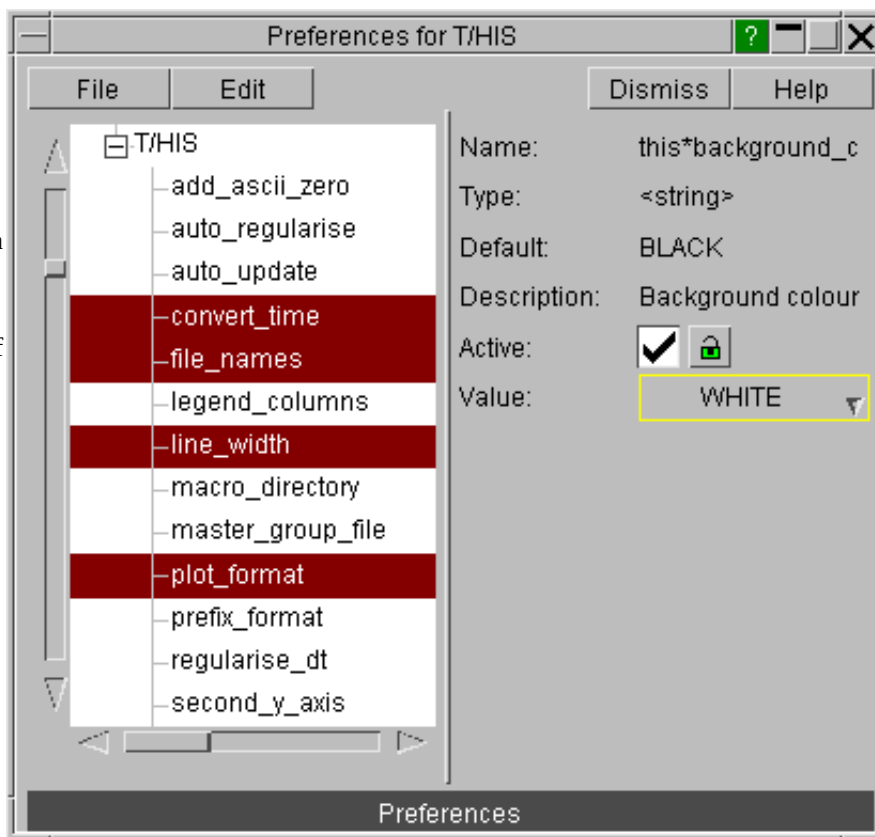
In this example the user is changing the background colour.

The option is "active" (ie present in the oa_pref file) and currently is set to WHITE.

Usage is:

- Select an option in the Tree on the left hand side
- Make it active / inactive
- If active select a value from the popup, or type in a value if necessary

The colour of the highlighting in the left hand side tree is significant:



Green

Means that the option has been read from your \$HOME/\$USERPROFILE file.

Red

Means that the option has been read from the \$OA_INSTALL file.

Magenta

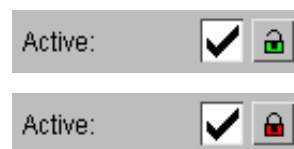
Means that the option had been read from the \$OA_ADMIN file.

In either event, regardless of the data source, the updated option will be written to the file chosen when you started the preferences editor.

Because of the order of file reading ([see above](#)), and option read from the master \$OASYS file, amended, and written to your local \$HOME file will take precedence when you next run T/HIS.

Locking Preferences

From version 9.4 onwards preferences can be locked. Beside each option in the preference editor is a padlock symbol. If the symbol is green then the option is unlocked, if it is red then it is locked. If a preference option has been locked in a file that the user can not modify then an error message will be generated if the user tries to edit that option.



If a user manually edits the "oa_pref" file to try and set an option that has been locked in another preference file then the option will be ignored in the users preference file.

Format of the **oa_pref** file

Entries are formatted in the following way: **<programme>*<option>: <setting>**

For example: **this*laser_paper_size: A4**

The rules for formatting are:

- The **<programme>*<option>**: string must start at column 1;
- This string must be in lower case, and must not have any spaces in it.
- The **<setting>** must be separated from the string by at least one space.
- Lines starting with a "#" are treated as comments and are ignored.

(Users accustomed to setting the attributes of their window manager with the **.xdefaults** file will recognise this format and syntax.)

"oa_pref" arguments valid for T/HIS.

The following options are available to control how T/HIS starts.

Preference	Type	Description	Valid arguments	Default
add_ascii_zero	<logical>	Automatically add point at time zero if required	TRUE, FALSE	FALSE
auto_regularise	<logical>	Always regularise curves before filtering	TRUE, FALSE	FALSE
auto_update	<logical>	Automatically replot graph after changing axis/title options	TRUE, FALSE	TRUE
convert_time	<logical>	Automatically convert from ms->s when filtering	TRUE, FALSE	FALSE
file_names	<string>	Controls default file filters. LSTC = d3thdt*, xfile*, OASYS/ARUP = *.thf, *.xtf	OASYS, ARUP, LSTC	OASYS
legend_columns	<string>	Number of columns to display in legend	1, 2, 3	2
line_width	<real>	Default line width for curves (pixels)		2.0
macro_directory	<string>	Specify a directory for T/HIS to look in for MACRO definitions		\$OASYS/this_library/macros
master_group_file	<string>	Filename for default group information		<none>
plot_format	<string>	Default format of plot	DEFAULT, AUTO, FULL, FLOATING	DEFAULT
prefix_format	<string>	Prefix for	MODEL, DIRECTORY, ROOTNAME, USER	MODEL
regularise_dt	<real>	Time interval for automatic curve regularisation		0.0001
second_y_axis	<logical>	Display 2nd y axis	TRUE, FALSE	FALSE
show_hic_value	<string>	Display HIC value	ON, OFF	OFF
show_3ms_value	<string>	Display 3ms Clip value	ON, OFF	OFF
show_thiv_value	<string>	Display THIV value	ON, OFF	OFF
show_phd_value	<string>	Display PHD value	ON, OFF	OFF
start_in	<string>	Directory to start T/HIS in		<none>
vc_method	<string>	Default method for calculating Viscous Criteria	ECER95, IIHS	ECER95

The following strings and values control display options

Preference	Type	Description	Valid arguments	Default
axis_width	<real>	Default line width for axis (pixels)		2.0

axis_colour	<string>	Axis colour	FOREGROUND, BACKGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
border_on	<logical>	Display border	TRUE, FALSE	TRUE
border_width	<real>	Default line width for border (pixels)		1.0
border_colour	<string>	Border colour	FOREGROUND, BACKGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
grid_on	<logical>	Display grid	TRUE, FALSE	FALSE
grid_width	<real>	Default line width for grid (pixels)		1.0

The following strings and values control formatting of values for graphs

Preference	Type	Description	Valid arguments	Default
add_exponent_to_label	<logical>	Add axis multiplier to label	TRUE, FALSE	TRUE
x_axis_decimal_places	<string>	Number of decimal places displayed for X axis values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, Default(3)	Default(3)
x_axis_format	<string>	Format used to display X axis values	Automatic, General, Scientific, Default(Automatic)	Default(Automatic)
y_axis_decimal_places	<string>	Number of decimal places displayed for Y axis values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, Default(3)	Default(3)
y_axis_format	<string>	Format used to display Y axis values	Automatic, General, Scientific, Default(Automatic)	Default(Automatic)
y2_axis_decimal_places	<string>	Number of decimal places displayed for second Y axis values	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, Default(3)	Default(3)
y2_axis_format	<string>	Format used to display second Y axis values	Automatic, General, Scientific, Default(Automatic)	Default(Automatic)
colours				
background_colour	<string>	Background colour	WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	BLACK
foreground_colour	<string>	Foreground colour	WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	WHITE

user_colour1	<string>	User defined colour 1 (HEX RRGGBB value)		<none>
user_colour2	<string>	User defined colour 2 (HEX RRGGBB value)		<none>
user_colour3	<string>	User defined colour 3 (HEX RRGGBB value)		<none>
user_colour4	<string>	User defined colour 4 (HEX RRGGBB value)		<none>
user_colour5	<string>	User defined colour 5 (HEX RRGGBB value)		<none>
user_colour6	<string>	User defined colour 6 (HEX RRGGBB value)		<none>

The following options control the preferred order of [data sources](#) for various entities

Preference	Type	Description	Valid arguments	Default
global	<ordered>	Data source for global data	LSDA, ASCII, THF, none	<none>
part	<ordered>	Data source for part data	THF, LSDA, ASCII, none	<none>
node	<ordered>	Data source for node data	THF, LSDA, ASCII, none	<none>
elements				
solid	<ordered>	Data source for solid data	THF, LSDA, none	<none>
beam	<ordered>	Data source for beam data	THF, LSDA, none	<none>
shell	<ordered>	Data source for shell data	THF, LSDA, none	<none>
tshell	<ordered>	Data source for thick shell data	THF, LSDA, none	<none>
spring	<ordered>	Data source for spring data	XTF, LSDA, ASCII, none	<none>
seatbelt	<ordered>	Data source for seatbelt data	XTF, LSDA, ASCII, none	<none>
retractor	<ordered>	Data source for retractor data	XTF, LSDA, ASCII, none	<none>
slipping	<ordered>	Data source for slipping data	XTF, LSDA, ASCII, none	<none>
wall	<ordered>	Data source for rigid wall data	XTF, LSDA, ASCII, none	<none>
contact	<ordered>	Data source for contact data	XTF, LSDA, ASCII, none	<none>
reaction	<ordered>	Data source for nodal reaction data	XTF, LSDA, ASCII, none	<none>
airbag	<ordered>	Data source for airbag data	XTF, LSDA, ASCII, none	<none>
joint	<ordered>	Data source for joint data	LSDA, ASCII, none	<none>
section	<ordered>	Data source for section data	LSDA, ASCII, none	<none>
subsystem	<ordered>	Data source for subsystems data	LSDA, ASCII, none	<none>
geo_contact	<ordered>	Data source for geometric contact data	LSDA, ASCII, none	<none>
nodal_rb	<ordered>	Data source for nodal rigid body data	LSDA, ASCII, none	<none>

weld	<ordered>	Data source for spotweld data	LSDA, ASCII, none	<none>
spc	<ordered>	Data source for spc data	LSDA, ASCII, none	<none>
boundary	<ordered>	Data source for boundary data	LSDA, ASCII, none	<none>
fsi	<ordered>	Data source for fluid structural interaction data	ASCII, none	<none>
sph	<ordered>	Data source for SPH data	LSDA, ASCII, none	<none>

The following strings and values control [axes, title, and legend formatting](#) for graphs

Preference	Type	Description	Valid arguments	Default
title_size	<string>	Font size for title	8, 10, 12, 14, 18, 24, Default	Default
title_font	<string>	Font for title	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
title_colour	<string>	Colour of title	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
x_label_size	<string>	Font size for X axis label	8, 10, 12, 14, 18, 24, Default	Default
x_label_font	<string>	Font for X axis label	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
x_label_colour	<string>	Colour of X axis label	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
x_axis_size	<string>	Font size for X axis units	8, 10, 12, 14, 18, 24, Default	Default
x_axis_font	<string>	Font for X axis units	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
x_axis_colour	<string>	Colour of X axis units	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
y_label_size	<string>	Font size for Y axis label	8, 10, 12, 14, 18, 24, Default	Default
y_label_font	<string>	Font for Y axis label	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
y_label_colour	<string>	Colour of Y axis label	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
y_axis_size	<string>	Font size for Y axis units	8, 10, 12, 14, 18, 24, Default	Default
y_axis_font	<string>	Font for Y axis units	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
y_axis_colour	<string>	Colour of Y axis units	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND

y2_label_size	<string>	Font size for second Y axis label	8, 10, 12, 14, 18, 24, Default	Default
y2_label_font	<string>	Font for second Y axis label	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
y2_label_colour	<string>	Colour of second Y axis label	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
y2_axis_size	<string>	Font size for second Y axis units	8, 10, 12, 14, 18, 24, Default	Default
y2_axis_font	<string>	Font for second Y axis units	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
y2_axis_colour	<string>	Colour of second Y axis units	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND
legend_size	<string>	Font size for curve legends	8, 10, 12, 14, 18, 24, Default	Default
legend_font	<string>	Font for second curve legends	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
legend_colour	<string>	Colour of curve legends	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND

The following strings and values control how T/HIS starts

Preference	Type	Description	Valid arguments	Default
graphics_type	<string>	Graphics format to start T/HIS with	OPENGL, TTY, DEFAULT	OPENGL
maximise	<logical>	Maximise window when T/HIS started	TRUE, FALSE	FALSE
placement	<string>	Location for initial window on multi-screen display	LEFT, RIGHT, BOTTOM, TOP, LEFT_BOTTOM, LEFT_TOP, RIGHT_BOTTOM, RIGHT_TOP	<none>
white_background_image	<logical>	Write images with white background	TRUE, FALSE	FALSE

The following strings and values control laser plotting setup

Preference	Type	Description	Valid arguments	Default
laser_paper_size	<string>	Default paper size	A4, A3, US	A4
laser_orientation	<string>	Default page orientation	Portrait, Landscape	Landscape
laser_top_margin	<real>	Top margin size in mm		10
laser_bottom_margin	<real>	Bottom margin size in mm		30
laser_left_margin	<real>	Left margin size in mm		20
laser_right_margin	<real>	Right margin size in mm		10

The following options affect the appearance and behaviour of the graphical user interface, left handed support, and the mouse

Preference	Type	Description	Valid arguments	Default
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display_factor	<real>	Factor on display size (0.5-2.0)	0.5 - 2.0	1.0
display_brightness	<real>	Menu brightness (0.0-1.0)	0.0 - 1.0	1.0
display_saturation	<real>	Menu colour saturation (0.0-1.0)	0.0 - 1.0	1.0
dv_left_shift	<string>	Dyn view action for shift + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_shift	<string>	Dyn view action for shift + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_shift	<string>	Dyn view action for shift + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE
dv_left_ctrl	<string>	Dyn view action for ctrl + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_ctrl	<string>	Dyn view action for ctrl + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_ctrl	<string>	Dyn view action for ctrl + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE
dv_left_both	<string>	Dyn view action for shift+ctrl + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_both	<string>	Dyn view action for shift+ctrl + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_both	<string>	Dyn view action for shift+ctrl + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE
dv_shift_action	<string>	Dynamic viewing mode for shift + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	CURRENT
dv_ctrl_action	<string>	Dynamic viewing mode for ctrl + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	WIREFRAME
dv_both_action	<string>	Dynamic viewing mode for shift+ctrl + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	FREE_EDGE
font_size	<string>	Menu font size	SMALL, DEFAULT, LARGE	DEFAULT
font_type	<string>	Menu font typeface and strength	HELVETICA, HELVETICA-BOLD, TIMES, TIMES-BOLD, COURIER, COURIER-BOLD	HELVETICA
left_handed	<string>	Left handed switching of mouse and/or keyboard	NONE, MOUSE, KEYBOARD, ALL	NONE
zoom_factor	<real>	Zoom Factor for mouse wheel (0.01-0.2)	0.01 - 0.2	0.05
czoom_factor	<real>	Factor for right mouse dynamic zoom (0.01-0.2)	0.01 - 0.2	0.05
kzoom_factor	<real>	Factor for +/- keyboard short-cut keys	0.01 - 100.0	2.0

Keys can have functions assigned to them:

Preference	Type	Description	Valid arguments	Default
F1_key	<string>	Shortcut for F1		<none>
F2_key	<string>	Shortcut for F2		<none>
F3_key	<string>	Shortcut for F3		<none>
F4_key	<string>	Shortcut for F4		<none>
F5_key	<string>	Shortcut for F5		<none>
F6_key	<string>	Shortcut for F6		<none>
F7_key	<string>	Shortcut for F7		<none>
F8_key	<string>	Shortcut for F8		<none>
F9_key	<string>	Shortcut for F9		<none>
F10_key	<string>	Shortcut for F10		<none>
F11_key	<string>	Shortcut for F11		<none>
F12_key	<string>	Shortcut for F12		<none>
A_key	<string>	Shortcut for A		<none>
B_key	<string>	Shortcut for B		<none>
C_key	<string>	Shortcut for C		<none>
D_key	<string>	Shortcut for D		<none>
E_key	<string>	Shortcut for E		<none>
F_key	<string>	Shortcut for F		<none>
G_key	<string>	Shortcut for G		<none>
H_key	<string>	Shortcut for H		<none>
I_key	<string>	Shortcut for I		<none>
J_key	<string>	Shortcut for J		<none>
K_key	<string>	Shortcut for K		<none>
L_key	<string>	Shortcut for L		<none>
M_key	<string>	Shortcut for M		<none>
N_key	<string>	Shortcut for N		<none>
O_key	<string>	Shortcut for O		<none>
P_key	<string>	Shortcut for P		<none>
Q_key	<string>	Shortcut for Q		<none>
R_key	<string>	Shortcut for R		<none>
S_key	<string>	Shortcut for S		<none>
T_key	<string>	Shortcut for T		<none>
U_key	<string>	Shortcut for U		<none>
V_key	<string>	Shortcut for V		<none>
W_key	<string>	Shortcut for W		<none>
X_key	<string>	Shortcut for X		<none>
Y_key	<string>	Shortcut for Y		<none>
Z_key	<string>	Shortcut for Z		<none>
a_key	<string>	Shortcut for a		<none>
b_key	<string>	Shortcut for b		<none>
c_key	<string>	Shortcut for c		<none>
d_key	<string>	Shortcut for d		<none>
e_key	<string>	Shortcut for e		<none>
f_key	<string>	Shortcut for f		<none>
g_key	<string>	Shortcut for g		<none>
h_key	<string>	Shortcut for h		<none>
i_key	<string>	Shortcut for i		<none>
j_key	<string>	Shortcut for j		<none>
k_key	<string>	Shortcut for k		<none>
l_key	<string>	Shortcut for l		<none>
m_key	<string>	Shortcut for m		<none>
n_key	<string>	Shortcut for n		<none>
o_key	<string>	Shortcut for o		<none>
p_key	<string>	Shortcut for p		<none>
q_key	<string>	Shortcut for q		<none>
r_key	<string>	Shortcut for r		<none>
s_key	<string>	Shortcut for s		<none>

t_key	<string>	Shortcut for t	<none>
u_key	<string>	Shortcut for u	<none>
v_key	<string>	Shortcut for v	<none>
w_key	<string>	Shortcut for w	<none>
x_key	<string>	Shortcut for x	<none>
y_key	<string>	Shortcut for y	<none>
z_key	<string>	Shortcut for z	<none>
SPACE_key	<string>	Shortcut for space	<none>
ZERO_key	<string>	Shortcut for 0	<none>
ONE_key	<string>	Shortcut for 1	<none>
TWO_key	<string>	Shortcut for 2	<none>
THREE_key	<string>	Shortcut for 3	<none>
FOUR_key	<string>	Shortcut for 4	<none>
FIVE_key	<string>	Shortcut for 5	<none>
SIX_key	<string>	Shortcut for 6	<none>
SEVEN_key	<string>	Shortcut for 7	<none>
EIGHT_key	<string>	Shortcut for 8	<none>
NINE_key	<string>	Shortcut for 9	<none>
EXCLAMATION_key	<string>	Shortcut for !	<none>
DOUBLEQUOTE_key	<string>	Shortcut for "	<none>
HASH_key	<string>	Shortcut for #	<none>
DOLLAR_key	<string>	Shortcut for \$	<none>
PERCENT_key	<string>	Shortcut for %	<none>
AMPERSAND_key	<string>	Shortcut for &	<none>
SINGLEQUOTE_key	<string>	Shortcut for '	<none>
LEFTBRACKET_key	<string>	Shortcut for (	<none>
RIGHTBRACKET_key	<string>	Shortcut for)	<none>
ASTERISK_key	<string>	Shortcut for *	<none>
PLUS_key	<string>	Shortcut for +	<none>
COMMA_key	<string>	Shortcut for ,	<none>
MINUS_key	<string>	Shortcut for -	<none>
DOT_key	<string>	Shortcut for .	<none>
SLASH_key	<string>	Shortcut for /	<none>
COLON_key	<string>	Shortcut for :	<none>
SEMICOLON_key	<string>	Shortcut for ;	<none>
LESSTHAN_key	<string>	Shortcut for <	<none>
EQUALS_key	<string>	Shortcut for =	<none>
GREATERTHAN_key	<string>	Shortcut for >	<none>
QUESTIONMARK_key	<string>	Shortcut for ?	<none>
AT_key	<string>	Shortcut for @	<none>
LEFTSQUAREBRACKET_key	<string>	Shortcut for [	<none>
BACKSLASH_key	<string>	Shortcut for \	<none>
RIGHTSQUAREBRACKET_key	<string>	Shortcut for]	<none>
CIRCUMFLEX_key	<string>	Shortcut for ^	<none>
UNDERSCORE_key	<string>	Shortcut for _	<none>
BACKTICK_key	<string>	Shortcut for `	<none>
LEFTCURLYBRACKET_key	<string>	Shortcut for {	<none>
PIPE_key	<string>	Shortcut for	<none>
RIGHTCURLYBRACKET_key	<string>	Shortcut for }	<none>
TILDE_key	<string>	Shortcut for ~	<none>

The following strings control the T/HIS header and version number at the bottom right of the plot space

Preference	Type	Description	Valid arguments	Default
user_text_line_1	<string>	Text for line 1		<none>
user_text_line_2	<string>	Text for line 2		<none>

user_text_line_3	<string>	Text for line 3		<none>
user_text_line_4	<string>	Text for line 4		<none>
user_text_line_5	<string>	Text for line 5		<none>
user_text_line_6	<string>	Text for line 6		<none>
user_text_size_1	<string>	Size of text on line 1	8, 10, 12, 14, 18, 24, Default	Default
user_text_size_2	<string>	Size of text on line 2	8, 10, 12, 14, 18, 24, Default	Default
user_text_size_3	<string>	Size of text on line 3	8, 10, 12, 14, 18, 24, Default	Default
user_text_size_4	<string>	Size of text on line 4	8, 10, 12, 14, 18, 24, Default	Default
user_text_size_5	<string>	Size of text on line 5	8, 10, 12, 14, 18, 24, Default	Default
user_text_size_6	<string>	Size of text on line 6	8, 10, 12, 14, 18, 24, Default	Default
user_text_font	<string>	Font for user text	Helvetica_Medium, Helvetica_Bold, Courier_Medium, Courier_Bold, Times_Medium, Times_bold, Default	Default
user_text_colour	<string>	Colour for user text	FOREGROUND, WHITE, BLACK, RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, ORANGE, TURQUOISE, INDIGO, LIME, SKY, PINK, COL_15, COL_16, COL_17, COL_18, COL_19, COL_20, COL_21, COL_22, COL_23, COL_24, COL_25, COL_26, COL_27, COL_28, COL_29, COL_30, USER_1, USER_2, USER_3, USER_4, USER_5, USER_6	FOREGROUND

The following strings and values control the display of UNIT information in T/HIS

Preference	Type	Description	Valid arguments	Default
model_units	<string>	Sets the default UNIT system for models	U1 m:kg:s (SI), U2 mm:T:s, U3 mm:kg:ms, U4 mm:gm:ms, U5 ft:slug:s, U6 m:T:s	U1 m:kg:s (SI)
display_units	<string>	Sets the default UNIT system used to display results	U1 m:kg:s (SI), U2 mm:T:s, U3 mm:kg:ms, U4 mm:gm:ms, U5 ft:slug:s, U6 m:T:s	U1 m:kg:s (SI)
write_csv_units	<logical>	Write UNIT information to CSV files	TRUE, FALSE	TRUE

The following is an example file. Note that blank lines and lines not beginning **<programme name>:** are ignored, so comment lines may be added if required. However, lines to be read must start at column 1 and there must not be any gaps in the keyword.

```

this*laser_paper_size:      A4
this*laser_orientation:    Landscape
this*laser_mode:           Greyscale
this*user_text_line_2:      Design Project
this*user_text_line_4:      Phase II Results

```

The user preferences option is not available in command line mode, however the **oa_pref** file is read and applied. Setting paper size and margins can therefore only be done through this method.

Global preferences.

From version 9.3 onwards global preferences that apply to all programs can be specified using **"oasys"** as the program name.

oasys*<keyword>: <argument>

At present the following global preferences can be defined

If a preference is defined twice using both **"oasys"** and **"this"** then the **"this"** setting will override the global setting.

Preference	Type	Description	Valid arguments	Default
------------	------	-------------	-----------------	---------

file_names	<string>	Controls input filename syntax. LSTC = d3*, OASYS = job.ptf*	OASYS, LSTC	OASYS
maximise	<logical>	Maximise window when Program is started	TRUE, FALSE	FALSE
placement	<string>	Location for initial window on multi-screen display	LEFT, RIGHT, BOTTOM, TOP, LEFT_BOTTOM, LEFT_TOP, RIGHT_BOTTOM, RIGHT_TOP	<none>
start_in	<string>	Directory to start Program in		<none>
directories				
home_dir	<string>	"home" directory for user		<none>
install_dir	<string>	Directory Oasys Ltd software is installed in		<none>
manuals_dir	<string>	Directory user manuals are installed in		<none>
temp_dir	<string>	temporary directory for user		<none>
laser				
laser_paper_size	<string>	Default paper size	US, A4	A4
laser_orientation	<string>	Default page orientation	Portrait, Landscape	Landscape
laser_top_margin	<real>	Top margin size in mm		10
laser_bottom_margin	<real>	Bottom margin size in mm		30
laser_left_margin	<real>	Left margin size in mm		20
laser_right_margin	<real>	Right margin size in mm		10
menu attributes				
display_factor	<real>	Factor on display size (0.5-2.0)	0.5 - 2.0	1.0
display_brightness	<real>	Menu brightness (0.0-1.0)	0.0 - 1.0	1.0
display_saturation	<real>	Menu colour saturation (0.0-1.0)	0.0 - 1.0	1.0
dv_left_shift	<string>	Dyn view action for shift + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_shift	<string>	Dyn view action for shift + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_shift	<string>	Dyn view action for shift + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE
dv_left_ctrl	<string>	Dyn view action for ctrl + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_ctrl	<string>	Dyn view action for ctrl + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_ctrl	<string>	Dyn view action for ctrl + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE

dv_left_both	<string>	Dyn view action for shift+ctrl + Left mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ROTATION_XYZ
dv_middle_both	<string>	Dyn view action for shift+ctrl + Middle mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	TRANSLATION
dv_right_both	<string>	Dyn view action for shift+ctrl + Right mouse	ROTATION_XYZ, ROTATION_XY, ROTATION_Z, ROTATION_SPHERE, TRANSLATION, ZOOM_UP_+VE, ZOOM_DOWN_+VE, UNUSED	ZOOM_UP_+VE
dv_shift_action	<string>	Dynamic viewing mode for shift + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	CURRENT
dv_ctrl_action	<string>	Dynamic viewing mode for ctrl + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	WIREFRAME
dv_both_action	<string>	Dynamic viewing mode for shift+ctrl + mouse button	CURRENT, WIREFRAME, FREE_EDGE, UNUSED	FREE_EDGE
font_size	<string>	Menu font size	SMALL, DEFAULT, LARGE	DEFAULT
font_type	<string>	Menu font typeface and strength	HELVETICA, HELVETICA-BOLD, TIMES, TIMES-BOLD, COURIER, COURIER-BOLD	HELVETICA
left_handed	<string>	Left handed switching of mouse and/or keyboard	NONE, MOUSE, KEYBOARD, ALL	NONE
zoom_factor	<real>	Zoom Factor for mouse wheel (0.01-0.2)	0.01 - 0.2	0.05
czoom_factor	<real>	Factor for right mouse dynamic zoom (0.01-0.2)	0.01 - 0.2	0.05
kzoom_factor	<real>	Factor for +/- keyboard short-cut keys	0.01 - 100.0	2.0

APPENDIX I - Windows File Associations

I.1 WINDOWS (PC's)

Under Windows on PC it is possible to set up file associations so that double clicking on files with the **.thf**, **.xtf**, **.cur** and **.bdf** extension opens them automatically in T/HIS. It is also possible to set up shortcuts so that double-clicking on the T/HIS icon automatically starts the desired graphics mode.

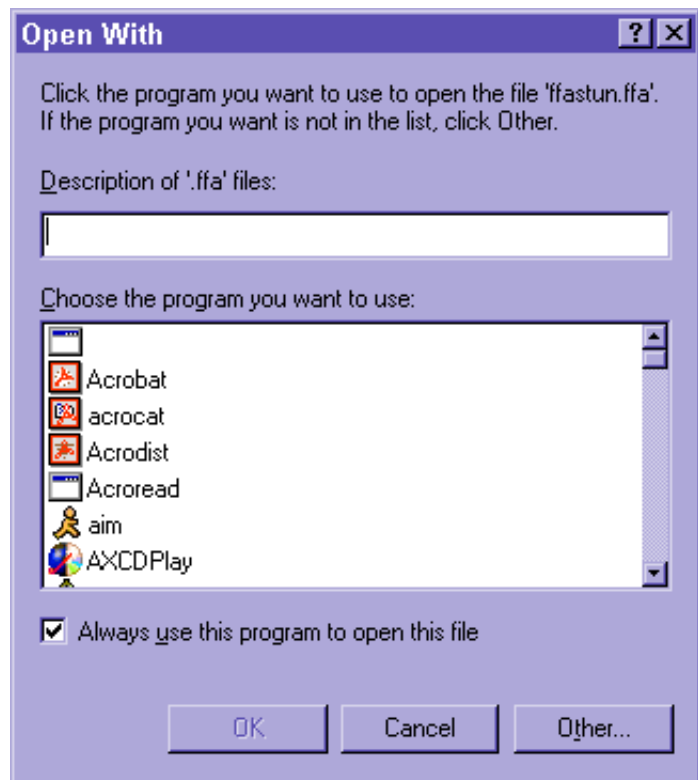
All of these settings are optional: you should be aware that under the Windows operating system associating a filetype (via its extension) with an application is convenient, but can also be restricting and hard to undo.

I.1.1 To make .thf files open in T/HIS by double-clicking on them

I.1.1.1 If .thf files do not currently have an application associated with them.

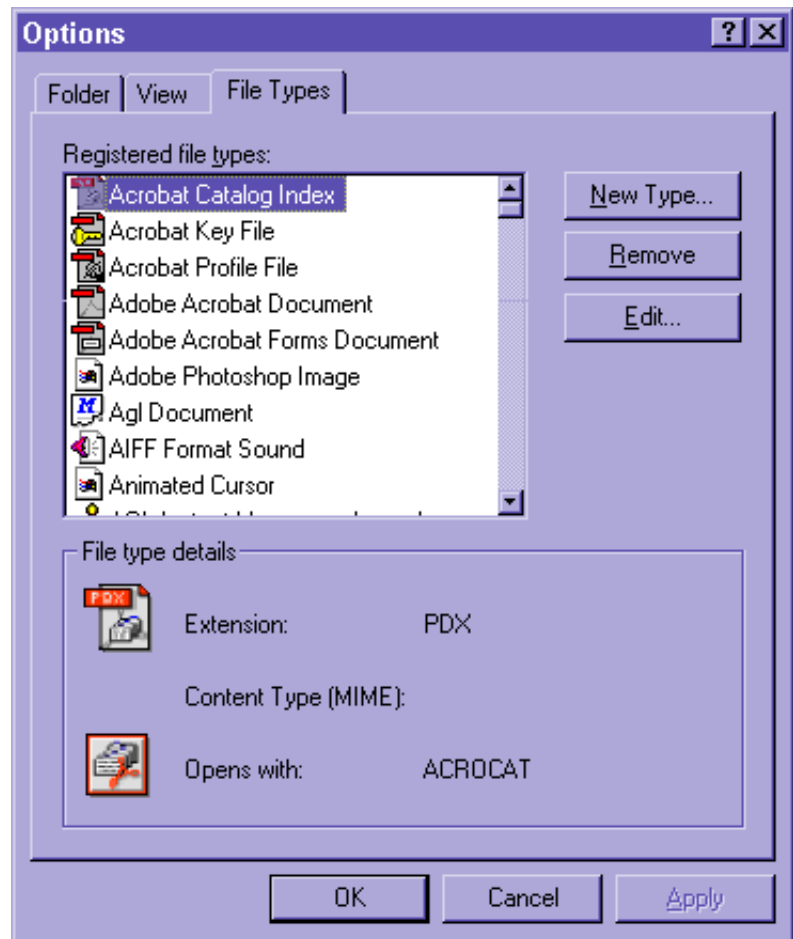
You can tell this because a "double-click" doesn't work, and they have some non-specific, usually "windows", icon.

- Right click on any **.thf** file, and select **Open with...** from the popup menu
- You will get the "Open with" panel.
- Type in a suitable description of the **.thf** files. For example: "LS-DYNA complete state file"
- Make sure that the **Always use...** box here is ticked,
- Use the directory browsing window to find the correct T/HIS executable. You are looking for file **this92.exe**. (If you can't remember where it is installed use **Start-> Find->Files** or **Folders** to locate it.)
- Click on **OK** to close the "Open With" window. This should start T/HIS, but at present it won't "know" about device type or filename: so select **STOP** to exit it.

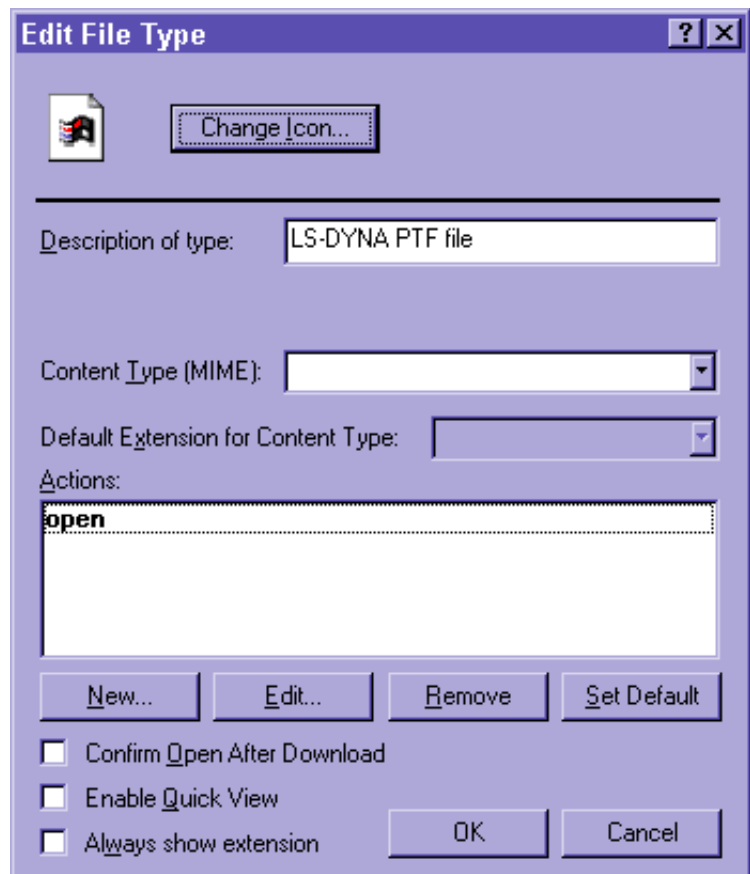


If T/HIS doesn't start check through what you've done, and ask Oasys Ltd for help if you can't resolve the problem.

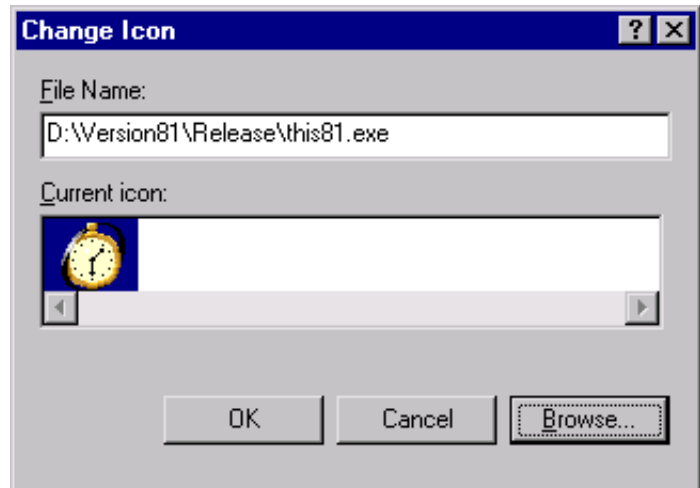
- In any folder window click on **View**, then select **Folder Options...** from the menu.



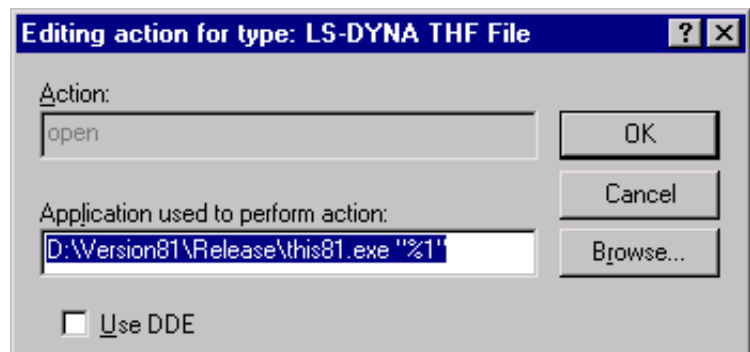
- Select the **File Types** tab at the top.
- Scroll down the list of Registered file types until you get to the name you entered for .thf files e.g. "LS-DYNA time history file". Highlight this and select **Edit...**



- In the Edit File Type panel click on **Change Icon...**
- And use **BROWSE...** in the Change Icon panel to find file **this82.exe**.



- Then, in the Edit File Type panel, click on **Edit...** to obtain the Editing action panel:



The Action: entry should be set to "open" (greyed out).

You now need to edit the contents of the **Application used...** box:

At this stage you must decide what graphics driver you wish T/HIS to open under. The options are:

- x X-Windows 2D graphics..
- tty No graphics. Suitable only for batch mode processing, producing laser output files, and not recommended for use here.
- default Is the same as x in this instance.

- Edit the existing string to remove the "%1" at its end and replace it with **-d=<option>** where <option> is one of the above. For example:

-d=x Selects X
 Lets T/HIS choose the best option
 -d=default

It is recommended that you use:

d=default Which will select X, and provide for any future options.

(Note that there must be no spaces in this definition: **-d = x** would cause an error. Also you must use lower case throughout. **-d=X** would also cause an error.)

- Click on **OK** in the Editing action window to close and save it.
- Click on **Close** in the edit File Type window to close and save it.

- Click on **Close** in the Folder Options window to close and save it.

You should now find that:

- All **.thf** files on your system show the T/HIS icon.
- Double-clicking on any such file starts T/HIS with the appropriate graphics driver, and opens that file.

It is not possible to set up the filename "d3thdt" for double-clicking in this way since Windows requires filename extensions when assigning applications to files.)

1.1.1.1 If **.thf** files do not currently have an application associated with them.

(2) If **.thf** files do currently have an application associated with them

- In any folder window click on **View**, then select **Folder Options...** from the menu.
- Select the **File Types** tab at the top.
- Scroll down until you find the file type currently associated with **.thf** files.
- Highlight it and click on **Edit...**

The procedure is then the same as the above, except that you are replacing...

- Icon (click on **Change Icon**)
- Application (**click on Edit...**)

...instead of defining new values.

If you are unsure it may be easier to **Remove** the current registered file type, then start afresh from (1) above.

1.1.2 To make **.xtf**, **.cur** and **.bdf** files open in T/HIS by double-clicking on them

The procedure is exactly the same as for **.thf** files, and must be carried out for each of the file types that you wish to process by double-clicking:

.xtf	LS-DYNA Extra Time History file
.cur	T/HIS Curve file
.bdf	T/HIS Bulk Data file

Note that: File types **.thf** and **.xtf** are opened in this way, but no contents are read in.

File types **.cur** and **.bdf** are opened and their complete contents read in.

APPENDIX J - Typed Commands

J.1 Global Menu

PL - Plot	CL - Clear Screen
ZM - Zoom	AU - Auto Scale Plot
CE - Centre	PT - Point on Screen
PF - Write Postscript file (use default)	
PC - Write Postscript file (Colour)	
PB - Write Postscript file (Blank/White)	
BL - Blank Curve	UB - Unblank Curve
RM - Remove a Curve	ER - Erase all curves
GS - Global Status	CO - Condense Curves
Y1 - 1st Y axis	Y2 - Second Y axis
DOU - Double Y axis (ON/ OFF)	
CF - Command file (read)	SF - Session file (write)
CS - Close session file	
EX - Exit	
! - Backspace	/ - Top level menu
Q - Abort operation	
; - End of command string	

J.2 List Commands

LS - List all files in current directory	LC - List all files "*.cur" in current directory
LB - List all files "*.bdf" in current directory	LK - List all files "*.key" in current directory
LI - List all files ASCII files in current directory	

<u>GM - Global Menu</u>	
---	--

MO - Model options	RE <file> - Read Model Files
	DA - Read Data from model
	GL <component> - Global data
	PA <id> <component> - Part data
	NO <id> <component> - Node data
	SO <id> <component> - Solid data
	BE <id> <component> - Beam data
	SH <id> <component> - Shell data
	TS <id> <component> - Thick Shell data
	WA <id> <component> - Part data
	SPR <id> <component> - Spring data
	SEA <id> <component> - Seatbelt data
	RET <id> <component> - Retractor data
	SL <id> <component> - Slipping data
	CO <id> <component> - Contact data
	REA <id> <component> - Reaction data
	AI <id> <component> - Airbag data
	JO <id> <component> - Joint data
	SEC <id> <component> - Section data
	SU <id> <component> - Subsystem data
	P_G <id> <component> - Part Group data
	G_C <id> <component> - Geometrical Contact data
	RI <id> <component> - Rigid Body data
	SPO <id> <component> - Spotweld data
	SPC <id> <component> - SPC data
	FS <id> <component> - Fluid structural interaction data
	BO <id> <component> - Boundary condition data
	SPH <id> <component> - SPH data
	SE - Select Models
	DE - Delete Models
	LI - List Models
	SU - Set Surface
RE - Read data	CU - Read T/HIS curve file
	CU NO - Read T/HIS curve file (ignore any style definitions)
	BD - Read Bulk data file
	KW - Read from LS-DYNA KEYWORD input file
	KY - Input curve from keyboard
	CSV - Read a CSV file (X,Y,X,Y,X,Y)
	CSV2 - Read a CSV file (X,Y,Y,Y,Y,Y)
	ISO - Read ISO curve data (multiple channels)
	ISO2 - Read ISO curve data (single channel)
WR - Write options	WR - Write curve file
	WA - Write all curves to a T/HIS curve file
	KEY - Write curves to a LS-DYNA Keyword file
	CSV - Write curves to a CSV file (X,Y,X,Y,X,Y)
	CSV2 - Write curves to a CSV file (X,Y,Y,Y,Y,Y)
	LI - List curve data on screen
	RE - Report curve data to file
	SU - Summary of curve
	ST - Status

DE - Defaults	AU - Auto Scaling	ON - Autoscaling on
		OFF - Autoscaling off
		DX - Define new x limits (minimum,maximum)
		XMN - Define new minimum x limit
		XXM - Define new maximum x limit
		DY - Define new y limit (min,max)
		YMN - Define new minimum y limit
		YMX - Define new maximum y limit
		2DY - Define new second y axis limits (min,max)
		YMN2 - Define new minimum second y limit
		YMX2 - Define new maximum second y limit
		ST - Status
	TI - Title	
	LA - Axes labels (user defined)	AU - Use automatic axes labels (both)
		AX - Use automatic x axis labels
		AY - Use automatic y axis labels
		2AY - Use automatic 2nd y axis labels
		DX - Define new x axis plot label
		DY - Define new y axis plot label
		2DY - Define new 2nd y axis plot label
		ST - Status
	AW - Axis line width	
	AX - Axis types	
	AC - Axis Colour	
	GR - Grid lines	ON - Turn grid on
		OFF - Turn grid off
		AX - Automatic x-axis grid intervals
		AY - Automatic y-axis grid intervals
		MX - Manual x-axis grid intervals
		MY - Manual y-axis grid intervals
		IX - Define x-axis grid intervals
		IY - Define y-axis grid intervals
		OX - Define x-axis grid offset
		OY - Define y-axis grid offset
		TH - Define grid line thickness
	GW - Grid width	
	UL - User Line	
	LL - Line labels	
	MP - Model Prefix	ON - Turn model prefix on
		OFF - Turn model prefix off
		AUTO - Add prefix if more than one model
	PR - Prefix Format	ID - Model ID
		DIR - Model directory
		THE - Root of THE filename
		USER - User defined
	PE - Plot format	
	WX - Window size (x) "pixels"	
	WY - Window size (y) "pixels"	
	RV - Reverse Foreground / Background	
	FO - Foreground Colour	
	BA - Background Colour	
	CU - Curve through points ON/OFF	
	SY - Symbols ON/OFF	
	BD - Border ON/OFF	
	BW - Border width	
	BC - Border Colour	
	LW - Default line width	
	SMN - Show minimum value	
	SMX - Show maximum value	
	LXMN - Label x value at minimum	
	LYMN - Label y value at minimum	
	LXXM - Label x value at maximum	

	LYMX - Label y value at maximum
	RE - Reset to defaults
	ST - Status
FO - Font	TI <size> <colour> - Title
	XL <size> <colour> - X Axis Label
	XU <size> <colour> - X Axis Units
	YL <size> <colour> - Y Axis Label
	YU <size> <colour> - Y Axis Units
	Y2L <size> <colour> - 2nd Y Axis Label
	Y2U <size> <colour> - 2nd Y Axis Units
	LE <size> <colour> - Curve Legend
	ALL <size> <colour> - All labels
ED <curve ID> - Edit option	E - move Forward next 16 lines
	B - move Back 16 lines
	T - move to Top of curve
	E - move to End of curve
	n(umber) - move to line n
	C n - Change line n
	I n - Insert before line n
	A n - Append after line n
	D n1 n2 - Delete from line n1 to n2
	L - change Line label
	R - Reset edited curve back to original
	W or S - write curve
	PE - Plot Edited curve
	PA - Plot Edited And original curve
	PL - PLot stored T/HIS curves
	Q - Quit the editor
OP - Operate	ADX/Y - Add
	MUX/Y - Multiply
	SUX/Y - Subtract
	DIX/Y - Divide
	CAT - Concatenate 2 curves
	MAP - Map one curve onto another
	COM - Combine curves
	ERR - Error functions
	INT - Integrate
	DIF - Differentiate
	SMO - Smooth
	LSQ - Least squares fit
	SQR - Square root
	NOR - Normalise
	REC - Reciprocal
	ABS - Absolute values
	TRA - Translate
	REV - Reverse
	CLP - Clip
	ZERO - Translate the curve to (0,0)
	ORDER - Reverse the order of the curve points
	VEC - Vector magnitude
	VEC2 - Vector Magnitude (2D)
	SUM - Sum of 'n' curves
	ENV - Envelope of 'n' curves
	MIN - Minimum of 'n' curves
	MAX - Maximum of 'n' curves
	AVE - Average of 'n' curves
	R-AV - Rolling Average of 'n' curves
	STR - Convert stress/strain curve

AM - Automotive options	C60 - Class 60 filter
	C180 - Class 180 filter
	C600 - Class 600 filter
	C1000 - Class 100 filter
	BUT - Butterworth filter
	FIR - FIR filter
	HIC - HIC value
	HICD - HIC(d) value
	CLI - 3ms Clip value
	EXC - Exceedence Plot
	VC - Viscous Criteria (ECER95)
	VC2 - Viscous Criteria (IIHS)
	ASI - Acceleration Severity Index
	THIV - Theoretical Head Impact Velocity
	NIJ - Neck Injury
	TTI - Thoracic Trauma Index
	NOR - Normalise
	REG - Regularise
	VEC - Vector Magnitude
	VEC2 - Vector Magnitude (2D)
	ACU - Airbag Control Unit
MA - Maths operations	SQRT - Squire Root
	LOG - Natural Log
	EXP - e to power of
	LOG10 - Log to base 10
	** - To raise to power
	SIN - Sine
	COS - Cosine
	TAN - Tangent
	ASIN - Arc sine
	ACOS - Arc cosine
SE - Seismic options	ATAN - Arc tangent
	DV - Displacement to velocity spectra
	DA - Displacement to acceleration spectra
	VD - Velocity to displacement spectra
	VA - Velocity to acceleration spectra
	AD - Acceleration to displacement spectra
	AV - Acceleration to velocity spectra
	DS - Produce a design spectrum from a response spectrum
UT - Utility functions	RS - Produce response spectra from input accelerations
	EFT - Fast fourier transformation
	CL - Colour laser output
	GL - Greyscale laser output
	LW - Line width
ST - Line styles	SA - Solid axes (x=0 & y=0 axes solid)
	RE - Read in style file
	WR - Write out style file
	DE - Reset styles to default settings
	SET - Set a T/HIS line style
HE - Help	FIX - Turn fix line styles on/off
CU - Curve editing options	LA - Set a new curve label
	TI - Set a new curve title
	XL - Set a new curve x-axis label
	YL - Set a new curve y-axis label
	TA - Set a new curve tag
GRO - Group options	READ - Read a T/HIS group file
	LIST - List all T/HIS groups
	DELETE - Delete all T/HIS groups
	CREATE - Create a new T/HIS group

IM - Image output options	JPEG <file> - Capture a JPEG image
	BMP_U <file> - Capture an uncompressed Bitmap image
	BMP_C <file> - Capture a compressed Bitmap image
	PPM <file> Capture a portable pixmap file
PREF - Define T/HIS user preferences	REG - Set time interval for automatic curve resampling
	CONV - Set/unset automatic conversion from ms to s when filtering
	FILE - Turn on/off output of injury criteria values and error calculations to ASCII files
	SHOW - Turn on/off display of HIC/ 3ms clip values
	ZERO - Turn on/off automatic creation of (0,0) point when reading data from ASCII files

Installation organisation

1 Introduction

Up to and including release 9.3 of the software the installation was organised thus:

OASYS directory	All executables Top level oa_pref file Job queue control files Other configuration files
+---/manuals	The various user manuals
+---/d3plot_library +---/primer_library +---/reporter_library +---/this_library	Scripts and macros used by the respective programmes

The various directories used for files were the system standard directories, or hard-wired to the top-level **OASYS** directory

Directory	Unix/Linux	Windows
User's home directory	\$HOME Typically ~<username>	%USERPROFILE% Typically C:\Documents and Settings\<username>
Temporary file directory	P_tmpdir Typically /tmp or /var/tmp	%TEMP% Typically C:\Documents and Settings\<username>\Local settings\Temp
Manuals directory	\$OASYS/manuals	%OASYS%\manuals
Scripts directory	\$OASYS/<prog>_library	%OASYS%\<prog>_library

2 Problems with the existing installation structure

This organisation has been reasonably successful for single users and small organisations, but it has proved unwieldy for larger organisations for the following reasons:

- Large organisations generally imply large networks, and it is often the case that the performance of these networks can be intermittent or poor, therefore it is common practice to perform an installation of the software on the local disk of each machine, rather than having a single installation on a remote disk.

This avoids the pauses and glitches that can occur when running executable files over a network, but it also means that all the configuration files in, or depending upon, the top level "OASYS" directory have to be copied to all machines and, more to the point, any changes or additions to such files also have to be copied to all machines.

Therefore some method of decoupling the "installation directory" from the "administration and configuration directory" is required.

- In larger organisations the "one person per computer" philosophy may not apply, with the consequence that users will tend to have a floating home area on a network drive and may not use the same machine every day.

This is not usually a problem on Unix/Linux where the "home" directory is tied to the login name not the machine. However on Windows platforms it means that %USERPROFILE%, which is typically on the local C drive of a machine, is not a good place to consider as "home" since it will be tied to a given computer, therefore a user who saves a file in his home directory on machine A may not be able to access it from machine B.

Therefore a more flexible definition of "home" is required.

- In a similar vein placing large temporary files on the /tmp partition (Unix/Linux) or the C: drive (Windows) may result in local disks becoming too full, or quotas exceeded.

Therefore a more flexible definition of "temporary disk area" is required.

3 Improved Installation structure from release 9.4 onwards

In order to try to improve the situation the installation configuration from release 9.4 onwards has been changed as follows:

Directory	Status	Directory Content and purpose	oa_pref file option
OA_ADMIN_xx	<i>Optional</i>	Top level configuration files. (xx = 94 for release 9.4, thus OA_ADMIN_94) Admin level oa_pref file Other configuration files Timeout configuration file	
OA_ADMIN	<i>Optional</i>	Same as OA_ADMIN_94 . <i>If OA_ADMIN_94 is not defined then this non-release specific version is checked.</i>	
OA_INSTALL	<i>Optional</i>	All executables Installation level oa_pref file	oasys*install_dir: <pathname>
OA_MANUALS	<i>Optional</i>	Specific directory for user manuals. If not defined then will search in: OA_ADMIN_xx/manuals (xx = major version number) OA_INSTALL/manuals	oasys*manuals_dir: <pathname>
OA_HOME	<i>Optional</i>	Specific "home" directory for user. If not defined will use: \$HOME (Unix/Linux) %USERPROFILE% (Windows)	oasys*home_dir: <pathname>
OA_TEMP	<i>Optional</i>	Specific "temporary" directory for user. If not defined will use: P_tmpdir (Unix/Linux) %TEMP% (Windows)	oasys*temp_dir: <pathname>

It will be clear from the table above that none of Environment variables have to be set, and that all defaults will revert to pre-9.4 behaviour. In other words users wishing to keep the status quo will find behaviour and layout unchanged if they do nothing.

OA_INSTALL

Previously the software used the **OA_INSTALL** (renamed from **OASYS**) environment variable to locate the directory the software was installed in.

- On Windows this is no longer required as the software can work out it's own installation directory. As this environment variable is no longer required it is recommended that it is removed from machines it is currently set on as in some cases where more than one version has been installed in different directories it can cause problems.
- On UNIX/LINUX systems the "oasys_94" script that starts the SHELL automatically sets this Environment Variable and passes it to any application started from the SHELL. If you run applications directly from the command line and bypass the SHELL then you should set **OA_INSTALL** so that the software can locate manuals and other required files.

OA_ADMIN_xx

Users wishing to separate configuration and installation directories will be able to do so by making use of the new top level **OA_ADMIN_xx** directory.

3.1 Dynamic configuration using the top level oa_pref file.

A further improvement is that all environment variables below **OA_ADMIN_xx** may either be set explicitly, or dynamically using the options in the `oa_pref` file at the top **OA_ADMIN_xx** level. This permits parallel installations of different versions of the software to co-exist, with only the top level administration directory names being distinct. For example:

Release 9.4	Release 9.5
Top level directory OA_ADMIN_94	Top level directory OA_ADMIN_95
<code>oa_pref</code> file in OA_ADMIN_94 contains: oasys*install_dir: <i><pathname for 9.4 installation></i> oasys*manuals_dir: <i><pathname for 9.4 manuals></i> oasys*home_dir: <i><pathname for home directory></i> oasys*temp_dir: <i><pathname for temporary files></i>	<code>oa_pref</code> file in OA_ADMIN_95 contains: oasys*install_dir: <i><pathname for 9.5 installation></i> oasys*manuals_dir: <i><pathname for 9.5 manuals></i> } would almost certainly be unchanged between major } versions, although they could be different if desired
Pathnames in the <code>oa_pref</code> file may contain environment variables which will be resolved before being applied.	

3.2 The hierarchy of `oa_pref` file reading

It will be clear from the above that in a large installation the "`oa_pref`" files have a significant role. Each piece of software reads them in the following order:

OA_ADMIN_xx	Top level configuration
OA_INSTALL	Installation level
OA_HOME	User's personal "home" file
Current working directory	File specific to the current directory (rarely used)

The rules for reading these files are:

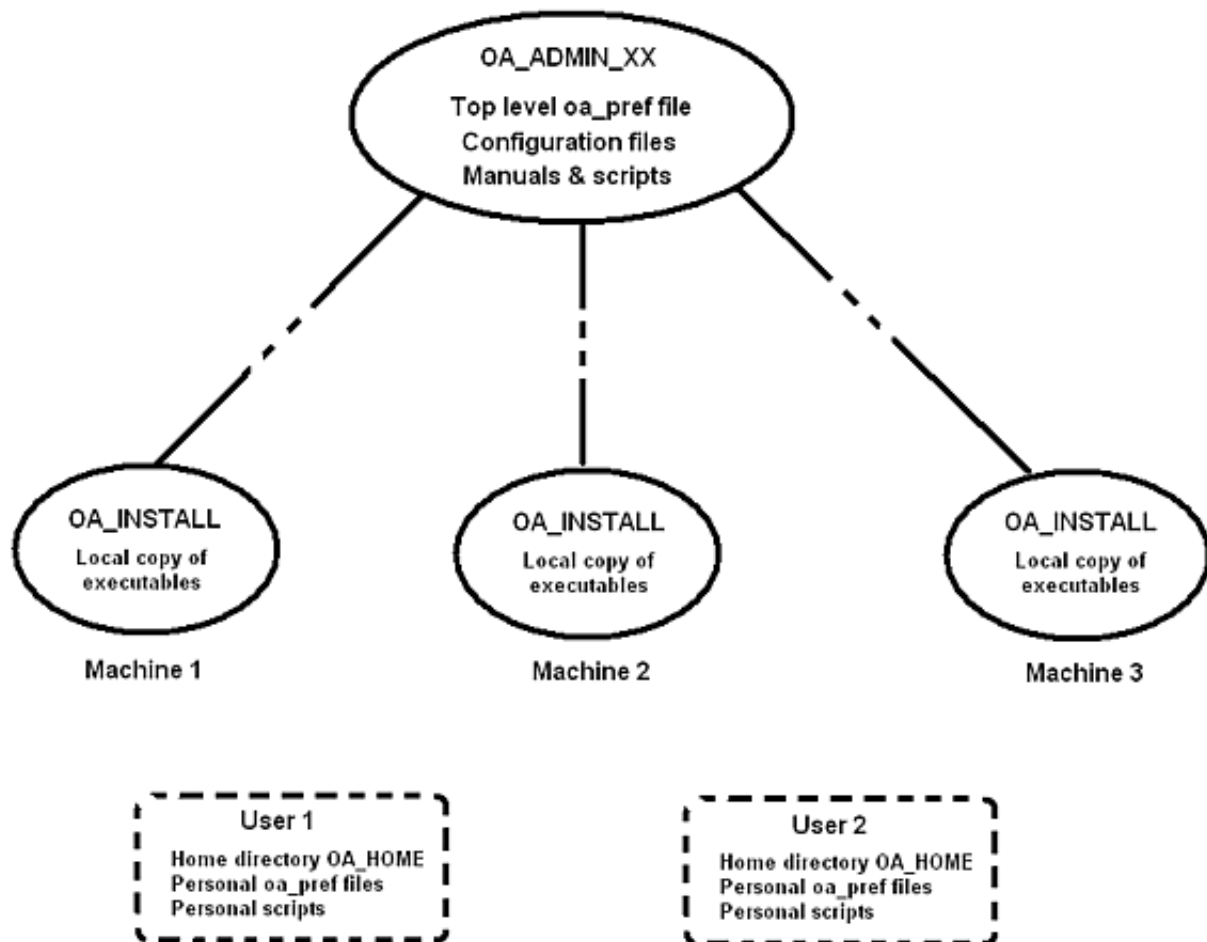
- If a given directory does not exist, or no file is found in that directory, then no action is taken. This is not an error.
- A more recently read definition supersedes one read earlier, therefore "local" definitions can supersede "global" ones (unless it was locked).
- If two of more of the directories in the table above are the same then that file is only read once from the first instance.

3.3 Locking Preference Options

From version 9.4 onwards preference options can be locked. If a preference option is locked in a file then that preference option will be ignored in any of the subsequent preference files that are read. By locking a preference option in a file that users do not have write access to a network administrator can control what options a user can modify.

3.4 Large Network Installation

A typical layout of a large networked installation might be:



In this example, preferences, manuals and scripts that are placed in `OA_ADMIN` will be available to all users. Changes to the preferences, scripts, etc need to be made only once (in `OA_ADMIN`) and do not need to be copied onto each local installation.